



# Fort Collins Science Center



*Science for Natural Resource Decisions*

*Fiscal Year 2005 Accomplishments*

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# U.S. GEOLOGICAL SURVEY FORT COLLINS SCIENCE CENTER

## Fiscal Year 2005 Accomplishments

### INTRODUCTION

In fiscal year (FY) 2005, the Fort Collins Science Center (FORT) continued to advance science critical for land and resource managers in Department of the Interior and other agencies. At FORT, our mission is to conduct research and develop technical applications to assist land managers and natural resource decision makers in understanding and managing biological resources, habitats, and ecosystems. To this end, staff scientists applied their expertise to resource management problems in the areas of aquatic systems, technology applications, ecosystem dynamics, invasive species, policy analysis and social science, and species and habitats of federal interest. This report summarizes key accomplishments in these areas in FY05.

### GOVERNMENT PERFORMANCE RESULTS ACT (GPRA) AND OTHER STRATEGIC GOALS: TOWARD RESOURCE PROTECTION AND SUSTAINING BIOLOGICAL COMMUNITIES ON DOI-ASSOCIATED LANDS

#### Center Accomplishments

Select FORT accomplishments are presented below, organized by USGS Biological Resources Discipline Program and primary associated goal. Although not identified here, many accomplishments meet other goals within and across these national programs.

#### Biological Informatics Program

***Goal 2. Develop, integrate, and apply tools that maximize the efficiency and effectiveness of user interactions with biological data and information.***

**NBII Southwest Information Node applications.** Two new applications were developed at FORT and added to the NBII Southwest Information Node (SWIN). The encroachment of wildfire on threatened and endangered species critical habitat can threaten that species' survival. The Southwest Threatened and Endangered Species application allows users to view maps of U.S. Fish and Wildlife Service (FWS) designated critical habitat for Southwest species with current and past fire locations. Users can also view critical habitat and wildfires in proximity to specific National Wildlife Refuges and National Parks. Other key issues facing management agencies in the arid Southwest include water availability and use, drought, and wildfire. Decisions on these issues must be based on sound science and data, but these are often scattered among a variety of federal, state, local, and tribal entities. The Water and Fire Environmental Resources (WAFER) application was developed to serve metadata about water and wildfire datasets from these agencies in a single location.

#### **Technical support for FWS Ecological Conservation On-line System (ECOS).**

FORT's Technology Applications Team (TAT) continued its support and program development of ECOS, the Service's premiere suite of Web applications serving the Division of Endangered Species, Division of Fisheries and Habitat Conservation, and the public

(<https://ecos.fws.gov>). TAT has more than a dozen information technology specialists devoted to providing day-to-day support and program development of more than two dozen major applications. In addition to millions of hits from ECOS' public access site, the secure site is accessed by more than 2000 registered users with special access and editing privileges. ECOS continues to grow each year in size, complexity, and functionality. With more than 200,000 documents and more than 1.7 terabytes of accessible data, ECOS is the Service's largest Web application. FY05 marked the 15<sup>th</sup> year of TAT's partnership with FWS.

## **Fisheries: Aquatic and Endangered Resources Program**

### ***Goal 2. Provide scientific information about factors and processes that affect aquatic organism health in support of survival, protection, conservation and recovery.***

**Forecasting habitat health on the Upper Delaware River.** USGS involvement in the Upper Delaware River Basin is the result of Congressional funding directed towards the study of instream habitat needs. The study, proposed by a coalition of nonprofit groups (including The Nature Conservancy, Trout Unlimited, and the Delaware River Foundation), is supported by the Delaware River Basin Commission. The goal is to develop ecological flow requirements for the



maintenance and restoration of healthy, self-sustaining and managed aquatic ecosystems in the Delaware Basin. This goal must be accomplished given the legal requirements for export of water from the rivers and downstream water delivery requirements for municipal water supplies. The FORT study includes consideration of instream habitat and water temperature as they influence ecological communities, with particular attention to brown and rainbow trout habitat. The goal is to substantially improve the ability to forecast fish habitat as a function of reservoir discharge on both a "real time" and planning basis for the New York-Delaware River reservoir system operation.

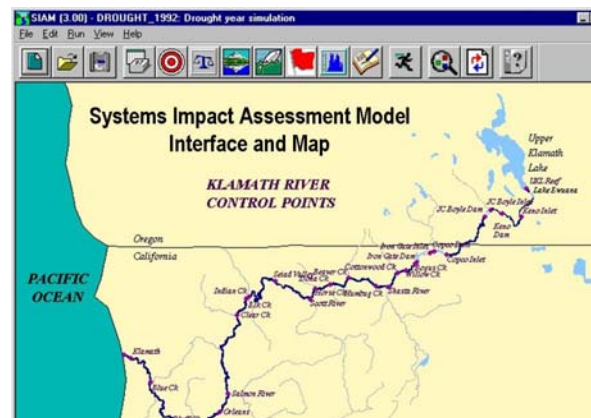
**Endangered Colorado River fish restoration and recovery.** The historical fish community of the mainstem Colorado River consisted of 9 species. Today, 7 are federally endangered and 2 have retreated further upstream. Efforts to augment declining populations have failed due to predation by recreational sport fish and by water development. A decade of predator removal efforts has not improved survival. To counter losses, agencies have pooled resources to first raise natives to a larger size in off-channel ponds and oxbows, which improves fish survival. FORT research fish biologist Gordon Mueller is working with other federal, state, tribal, and private parties in the creation of a system of small native fish sanctuaries, or "man-made" oxbows. These habitats would aid in conservation while providing researchers and managers opportunities to gain further knowledge and expertise on these rare fish. This adaptive management concept provides a realistic and economical approach to conservation and research while providing the means to determine if recovery is possible in the mainstem river.

**Goal 5. Develop research and technology tools to provide the scientific basis for developing adaptive management strategies and evaluating their effectiveness for restoration efforts to sustain aquatic resources.**

**Development of the Hydrologic Assessment Tool.** The Hydrologic Assessment Tool (HAT) is a Windows-based application that imports USGS gage station data on daily and peak flows and computes 171 indices that address five flow components: magnitude, frequency, duration, timing, and rate of change. Various output reports and graphs can be used to establish a hydrologic baseline time period, evaluate past and proposed hydrologic alterations, and establish environmental flow standards and recommendations. The software can be used for streams and rivers in the U.S. based on a general stream classification system; state-specific stream classifications and associated versions of the software are being developed for New Jersey and Missouri.

**Goal 6. Provide research support and technical assistance to DOI bureaus, other Federal and State government agencies, Tribes, and non-governmental groups to support natural resource management problem solving and decision making.**

**Support to FWS for Klamath River FERC relicensing.** A multi-agency group including the Office of the Secretary of the Interior, the Office of the Solicitor, BIA, FWS, BOR, BLM, and NPS are working with PacifiCorp in the Klamath Basin, Oregon and California, toward a Federal Energy Regulatory Commission (FERC) relicensing of hydropower facilities in the middle river basin. Two key elements of concern in the Klamath River mainstem are instream flows and water temperature as they affect anadromous fish populations (U.S. Fish and Wildlife Service 1991). The FORT-developed System Impact Assessment Model (SIAM) is being used to model various water management scenarios/alternatives being considered by the Klamath River collaborative working group. Specific activities in FY05 included modeling water temperatures in a bypass segment below J.C. Boyle reservoir, and reconstructing pre-project flows so that simulated flows can be compared for pre- and post-project time periods.



**Upper Klamath Basin integrated science project.** The Klamath Basin Rangeland Trust (KBRT) has been evaluating the effect of dryland grazing and riparian fencing as best management practices for reducing nutrient loading to Upper Klamath Lake in the Wood River Valley, Oregon. Anthropogenic nutrient loading has been identified as a factor in accelerating eutrophication of Upper Klamath Lake. USGS, as part of the Integrated Science Project in the Upper Klamath Basin, will collaborate with KBRT to evaluate the data collected and develop a land use model for the Wood River Valley that resource managers and land owners can use to plan, develop, and implement best management practices to reduce nutrient loading to Upper Klamath Lake.

## Invasive Species Program

### **Goal 1. Provide and coordinate the collection, synthesis, and accessibility of invasive species information (Information Management Goal)**

**Gathered datasets and synthesized patterns of invasion of plants, birds, and fish in the U.S. that demonstrated the positive relationship between native and non-native species richness within and across taxa.** The National Invasive Species Council needs baseline information on patterns of invasion related to species richness in the U.S. This is the first synthesis paper to examine patterns across taxa and illustrate that similar patterns exist in different taxonomic groups in patterns of species richness and invasion. It is another important study in the ongoing native/non-native richness debate showing the positive relationship between native and non-native species richness. It is also an essential backdrop to designing local-, regional-, and national-scale programs in prevention, early detection and rapid response, and restoration for multiple invasive taxa. Stohlgren et al. *Biological Invasions* (in press).

**Gathered datasets and synthesized patterns of plant invasions along latitudinal gradients in the U.S.** The National Invasive Species Council needs baseline information on patterns of invasion related to plant diversity in the U.S. This was the first synthesis of native and non-native plant diversity at continental scales. We found highly predictable patterns of invasion, where the density of non-native species in a county ( $\#/km^2$ ) was easily predicted by the density of native plant species. This is extremely important in designing local-, regional-, and national-scale programs in prevention, early detection and rapid response, and restoration. Stohlgren et al. 2005. *Ecology* 86(9):2298-2309.

### **Goal 2. Identify and report new invasions and assess risks to natural areas and waters (Early Detection and Rapid Assessment Goal)**

**Published steps required for “risk assessments of biological hazards” and for early detection surveys on invasive plants, animals, and diseases.** The National Invasive Species Council needs to develop an Early Detection/Rapid Response (ED/RR) plan for the U.S. This paper outlines the steps required for risk assessment and early detection surveys on invasive plants, animals, and diseases. It was the first paper to view invasive species as active “hazards.” The paper presents a standardized approach for federal land management agencies, tribes, state and local governments, and others involved in documenting species distribution patterns in space and time. Stohlgren and Schnase 2005 *Risk Assessment Journal* (in press).

**Improved survey and mapping techniques to overlay the patterns of rare endemic species distributions with hotspots of plant invasions.** Grand Staircase-Escalante National Monument, Utah, needs baseline information on patterns of endemism and invasion in the Monument. This study presented modeling techniques to evaluate overlap in rare/endemic species and unique native assemblages with patterns of invasion of non-native species in this two-million-acre Monument. These same techniques could be used at state, regional, and national scales. Stohlgren et al. 2005. *Ecological Applications* 15:715-725.



**Goal 3. Assess changes in populations and distributions of established invaders (Monitoring and Forecasting Goal)**

**Consolidated over 100 databases on tamarisk (salt cedar) distributions in the U.S. and developed the first habitat suitability model** by integrating the data with remote sensing information, and high performance computing. Team Tamarisk, the Tamarisk Coalition, and western states need baseline information on patterns of tamarisk invasion in the U.S., especially in the West. This paper demonstrates the tremendous value of consolidating databases (rather than just pointing to them or linking to them), and integrating the data with remote sensing information (MODIS, in this case) and high-performance computing to develop predictive spatial models of invasion potential. This also demonstrates the power of the NASA-USGS Invasive Species Forecasting System and the Global Organism Detection and Monitoring System. This too, is an essential building block of local-, regional-, and national ED/RR programs. Morissette et al. 2005 submitted to *Frontiers in Ecology and the Environment* (in review).

**Goal 4. Provide approaches to contain, reduce, and eliminate populations of invasive species and restore habitats and native species (Control and Management Goal)**

**Greatly improved trapping capabilities of lizards and snakes (e.g., the brown treesnake) to enhance early detection, rapid response, and monitoring.** The DOI's Office of Insular Affairs needs baseline information on brown treesnake invasion in the Pacific Basin. The invasive brown treesnake is a highly destructive species that has extirpated many native bird species on Guam, as well as bats and lizards. This study provided techniques to accurately quantify the abundance of prey and predator for early detection, rapid response, and monitoring on Guam and elsewhere. Cost-efficient trapping techniques, with modifications, can be useful worldwide for monitoring reptilian populations. Rodda et al. 2005, *Herpetological Review*, and Boyarski, Masters Thesis, CSU.

**Goal 5. Conduct research and develop methods and technologies to prevent the introduction of invasive species (Prevention Goal)**

**Quantified and validated visual searching techniques for the brown treesnake on Guam for early detection and rapid response programs throughout the Pacific Islands.** Brown treesnakes are on the move, with the latest snake found in Oklahoma. Shipping and air traffic out of Guam provides opportunities for this snake to be transported to other islands and beyond. Strategic visual searching techniques are the first step in early detection for rapid response and prevention of further invasions worldwide. Rodda et al. 2005, *Herpetological Review*.



Find the snake! (Hint:: look for curves.)

## Status and Trends of Biological Resources Program

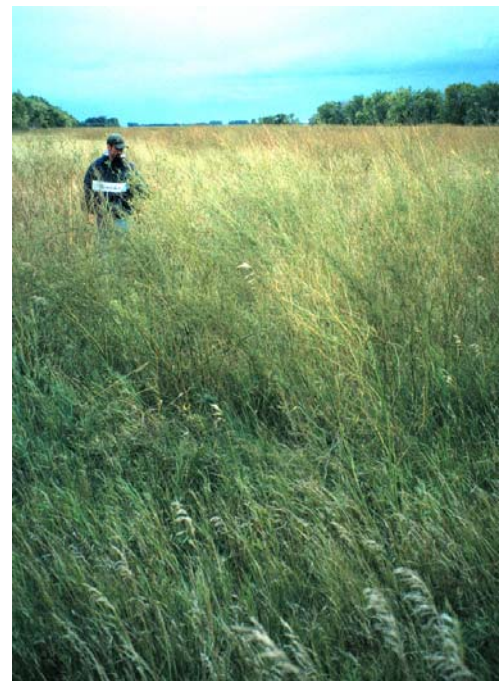
**Goal 1. Provide a framework that facilitates the integration of information from a variety of sources at multiple spatial and temporal scales to describe and track the abundance, distribution, productivity, and health of the Nations plants, animals, and ecosystems.**

**An integrated science approach to mapping fire effects.** Fort scientists completed the mapping of two field sites using historic aerial photos (both pre- and post-fire). The study sites included La Mesa (Bandelier National Monument, Santa Fe National Forest, and Los Alamos National laboratory, New Mexico), a 6,000-ha fire that burned in 1977; and Saddle Mountain (Grand Canyon National Park and Kaibab National Forest, Arizona), a 4,000-ha fire that burned in 1960. These burns were ideal for meeting our objectives because of their size, spatial variability, and availability of aerial photography that met our criteria for date and quality. One manuscript, entitled "Linking Hydrologic Response to Burn Severity after a Wildfire," was submitted to a special issue of the journal *Geomorphology*.

**Interactions of Society and the Environment Seminar Series.** For the 4th year in a row, PASA coordinated and sponsored this seminar series. The goal of the seminar series is to provide a forum, balanced between both students and professionals, to discuss societal involvement in natural resource policy and decisions. Current co-sponsors include the Rocky Mountain Research Station/USDA Forest Service and the Department of Journalism and Technical Communication at Colorado State University. In FY05, 10 seminars were held featuring local and guest speakers.

**Goal 2. Develop and evaluate inventory and monitoring methods, protocols, experimental designs, analytic tools, models, and technologies to measure biological status and trends.**

**Assistance to USDA, Conservation Reserve Program.** Managers of the USDA Farm Service Agency's Conservation Reserve Program (CRP) require more information on the biological effects of CRP policies. FORT scientists have continued to serve as experts in this area. FORT scientists have provided expertise in this area through their participation on the USDA Natural Resources Conservation Service Comprehensive Environmental Assessment Program (CEAP) Steering Committee; the International Association of Fish and Wildlife Agencies (IAFWA) Agricultural Conservation Task Force; and IAFWA's Conservation Security Program Subcommittee. In FY05 five manuscripts were completed and published as USGS Scientific Investigations Reports. Citation: Allen, A.W. and M.W. Vandever (eds). 2005. The Conservation Reserve Program-Planting for the Future: Proceedings of a National Conference, Fort Collins, CO, June 6-9, 2004. USGS Scientific Investigations Report 2005-5145.





**Support for development of Comprehensive Conservation Plans for FWS National Wildlife Refuges.**

The U.S. Fish and Wildlife Service (FWS) mandated Comprehensive Conservation Plans (CCP) requiring resource managers to include information regarding social and economic assessments of various management actions. FORT scientists continue to conduct socioeconomic studies related to visitor experience, and economic impact of a variety of management options and alternatives for FWS refuges in Regions 1, 5, and 6. FORT scientists completed a three-refuge visitor survey and presented the results to USFWS staff. The surveys focused on the likely social and economics impacts of various refuge management options. Results from the surveys provided socioeconomic data for use in the CCP planning process. Three completion reports for this project will be submitted and published as USGS Scientific Investigations Reports.

**Assistance to FWS on Comprehensive Conservation Planning at refuges:**

**Compliance with Service policies.** FORT scientists developed a high-quality, biologically sound training module that covers all aspects of the FWS Habitat Management Plan, Manual Chapter 620 FW I. FWS managers and planners continue to use this module to improve the design and quality of their Comprehensive Conservation Plans. One FORT scientist received the "Best Support of Planning Award" from FWS for his technical assistance over the past several years.

**FWS organizational assessment study.** In response to a research need, FORT scientists conducted a major study to assess the research capacity of the FWS. To better understand the nature, extent, quality, and administrative support for conducting research within the FWS, a one-year study was proposed, launched, and completed. FORT scientists completed a three-part study and submitted two reports to the U.S. Fish and Wildlife Service (Ratz, J.M., Ponds, P.D., Nielson, J.R., Liverca, J., and Lamb, B.L. 2005. Quality, quality, and support for research in the U.S. Fish and Wildlife Service: An organizational assessment. Final Report). This is the first synthesis of FWS research capacity since the organizational transfer of biological research functions in 1994.

**Mountain lion ecology.** As one of one of the "big three" charismatic predators in North America, mountain lions top the list of national park management challenges that require balancing the preservation of species with protection of park visitors. In Rocky Mountain National Park and its environs, FORT scientists are collaborating with the Colorado Division of Wildlife and park personnel in testing and evaluating invasive and noninvasive techniques for tracking and understanding the ecology of mountain lions. Park managers will use study results to more safely manage human-mountain lion interactions. Results will also be valuable to managers in other parks frequented by mountain lions or internationally, other big cats. This year's research effort was highlighted with the capture of a healthy adult female, which was fitted with a GPS radio-collar for tracking her movements, home range, and



feeding activity. The Colorado Mountain Lion Research Group, of which FORT is a part, initiated a project led by USDA-APHIS that will continue development and testing of a new, safe, park-friendly cage trap for mountain lion. Other work involved field tests using baiting, call boxes, and camera traps, including a digital video setup with which researchers successfully recorded several hours of feeding mountain lions and other predators.

**Developing riparian monitoring tools.** Working with the National Park Service (NPS), FORT ecologists are developing monitoring protocols for riparian areas. Although of limited spatial extent, riparian ecosystems of the Colorado Plateau are critical landscape elements with uniquely high levels of biological diversity. This study will help the NPS develop a monitoring protocol that will provide park managers with a baseline against which to gauge the long-term status and trends of riparian resources relative to natural processes and anthropogenic stressors. It will also provide a tool to evaluate the effectiveness of management interventions aimed at protecting or restoring riparian ecosystems.

***Goal 3. Collect, archive, and share selected, critical, high-quality monitoring data in cooperation with our partners to enable a determination of the status and trends of biological resources.***

**Institutional Analysis Workshop.** FORT scientists coordinated an international workshop in Fort Collins, Colorado, focusing on environmental decision-making. The purpose of the workshop was to advance social science theory and methods and improve practical applications for natural resource and environmental managers and planning teams. The workshop explored the tools of institutional analysis through presentations that described models, evaluated procedures, tested hypotheses, and reported practical applications.

**Natural Resource Negotiation Training.** In FY05, FORT scientists conducted three courses entitled “Basic Natural Resource Negotiation” (one was conducted in Seattle for Seattle City Light) and one course entitled “Advanced Natural Resource Negotiation” for over 70 natural resource professionals representing DOI agencies, USDA, state fish and wildlife agencies, and non-governmental organizations. The courses aim to improve negotiation skills among natural resource managers, thus helping them interact more effectively with the public and other agencies when managing the Nation’s fish and wildlife resources. Course evaluations show that, on average, the participants rank the course very good or excellent.

***Goal 4. Produce and provide analyses and reports that synthesize information on the status and trends of our Nations flora, fauna, and ecosystems and are responsive to the needs of the scientific community, land and resource managers, policy makers, and the public.***

**Protecting playas.** Playas are small, isolated wetlands found throughout the central and southern High Plains that support a significant portion of the region's biodiversity. Agricultural activities, mineral extraction, and other land uses in the Playa Lakes Region, including the Oklahoma panhandle, have led to severe degradation and loss of playas due to sedimentation. Contaminants such as nutrients, pesticides, heavy metals, and industrial wastes also threaten playas. Buffer strips of native grasses can protect playas from runoff that contains sediments and contaminants. The Playa Lakes Joint Venture asked the FORT to develop an annotated

bibliography and synthesis summarizing what is known about grass buffers and their protective capabilities for isolated wetlands. These reports will help decision makers determine optimal buffer design for that region, assess the potential for buffers to prevent runoff from filling playas, and better understand avian use of grass buffers.

**Assessing jumping mice.** Results of a recent taxonomic study on subspecies of the meadow jumping mouse suggest that the threatened Preble's meadow jumping mouse is not a valid subspecies. This matters to the U.S. Fish and Wildlife Service, which is conducting a 5-year review of the Preble's meadow jumping mouse to evaluate its status as a threatened subspecies under the Endangered Species Act. FORT researchers are lending technical assistance by reviewing and summarizing available information pertaining to meadow jumping mice on the Northern Great Plains, including distribution, habitat preference, abundance, and population trends. They are also conducting field work to document distribution and occurrence of meadow jumping mice in the Northern Great Plains and collecting additional samples for genetics analysis by the Leetown Science Center.

## Terrestrial, Freshwater and Marine Ecosystems Program

### ***Goal 1. Quantify and understand factors influencing patterns of temporal and spatial variability in key ecosystem components.***

#### **Assessing and understanding**

**sagebrush ecosystems.** A sagebrush research group comprising scientists from FORT, FRESC, and CSU is working with BLM, NPS, and FWS to prioritize management and research needs for imperiled sagebrush ecosystems. These scientists are working together to identify important wildlife-habitat relationships as well as thresholds for industrial development and human activities that will ensure the persistence of wildlife species of special concern as part of the



Wyoming Basin Ecoregional Assessment. This work is providing a current assessment of habitats and status of sagebrush-associated species as well as developing spatially explicit models of potential effects of landscape change in sagebrush ecosystems. Four additional tasks focusing on sagebrush ecosystems were initiated in FY05.

**Evaluating road and trail impacts on elk and Sage-Grouse.** Scientists from FORT are teaming up with multiple agencies and private landowners to evaluate the effects of roads and traffic patterns on elk and Sage-Grouse in western Colorado. On public lands, elk threaten Sage Grouse habitat and compete with domestic livestock for available forage; on private lands, they damage orchards and diminish fodder for livestock. In western Colorado, management of elk herds in the area is a shared responsibility of NPS, BLM, USDA-FS, and the Colorado Division of Wildlife (CDOW). These agencies are participating in an adaptive management project that is monitoring the intensity of motorized vehicle and trail use as well as animal movements to evaluate human access as a tool for wildlife management.

**Assessing herbivore-ecosystem interactions and impacts.** Ungulate ecologists at FORT are investigating the recovery of willow thickets on Yellowstone's northern winter range in apparent response to wolf restoration in 1995. The purpose of this investigation is to determine the extent of the apparent height and area release of willows across Yellowstone's northern range. The work entails mapping willow distribution and assessing the number of thickets established post-wolf versus pre-wolf. This work is also documenting the effects of willow thicket formation and post-wolf restoration on ecosystem processes, nutrient inputs to the ecosystem, plant community structure and microclimate, and any potential spiraling effects of thicket formation on downstream vegetation structure and recruitment. Simple models will project the extent of willow thicket recovery that will occur under a variety of weather patterns (normal, wet, dry), wolf densities (high, low), and elk population sizes (current, higher, lower).

***Goal 3. Develop indexes of ecosystem sensitivity to change and vulnerability to potential stressors, and tools to predict ecosystem responses to environmental change.***

**Atmospheric deposition and biogeochemical processes.** FORT ecologists are working with other USGS disciplines, the EPA, NPS, and USDA-FS to assess ecological and biogeochemical responses to changing atmospheric nitrogen (N) and sulphur (S) deposition at local to regional scales. N and S inputs cause complex responses in ecosystems including fertilization, forest ecosystem decline, lake and stream eutrophication and acidification, loss of soil base cations, and alterations of disturbance regimes. This study is refining, testing, and applying ecological process models to diverse ecosystems across the U.S. to better understand biogeochemical processes related to atmospheric deposition, forecast responses to changing atmospheric deposition, and assist in the formulation and evaluation of new, innovative ecosystem approaches and benchmarks.



***Goal 4. Devise a restoration and adaptive management framework for impaired ecosystems.***

**Science-based flow recommendations.** FORT riparian ecologists provide scientific leadership in working with over 50 stakeholders to develop a unified flow recommendation for the Bill Williams River in Arizona. The operations of Alamo Dam on the Bill Williams River are being revised to include downstream values other than the traditional irrigation and municipal water delivery, and power generation. Pat Shafroth is leading a diverse group of scientists and managers to help provide a scientific basis for decisions on flows that will meet multiple natural resource objectives. Previous work on this project has documented the effects of Alamo Dam operations on fluvial geomorphology and riparian vegetation along the river. The work was complex and interdisciplinary, including linkages between streamflow, fluvial processes, groundwater hydrology, and riparian vegetation at multiple spatial and temporal scales. As a result of this collaborative work, the U.S. Army Corps of Engineers and



the Bureau of Reclamation are conducting an adaptive management program using the unified flow recommendations.

#### **Wild horse research.** USGS

Wild Horse and Burro Research Program helps the BLM develop improved methods for estimating numbers of wild horses. The BLM is responsible for the management of 178 wild horse and 51 wild burro populations located across more than 88 millions acres of public lands. FORT has teamed up with the BLM and CSU to test aerial survey techniques for wild horses and burros in an effort to



find a more accurate way to estimate population numbers. By introducing statistical sampling methodology and analysis, and adapting some well-known survey techniques, this research is aimed at producing some statistically sound, tested, and defensible population survey techniques to assist the BLM in managing the controversial and complex wild horse program.

### **Wildlife and Terrestrial Resources Program**

**Goal 1. Provide the scientific foundation for the conservation of terrestrial plants, wildlife, and habitats by developing the basic biological information that partners need to formulate adaptive management strategies.**

**Greater Sage-Grouse.** The Greater Sage-Grouse recently was considered for listing under the Endangered Species Act. While it did not warrant the listing based on current science, questions remain about the genetic viability of, and distinctions between, different populations of this bird. Sage-Grouse currently inhabit 56% of their historic range, leaving some populations isolated from each other. FORT scientists recently completed DNA analysis of Greater Sage-Grouse sampled across their entire range of 11 states (including Wyoming) and two Canadian provinces (Oyler-McCance, et al. 2005. A multilocus population genetic survey of Greater Sage-Grouse across their range. *Molecular Ecology* 14:1293-1310). These data evaluate boundaries between Greater and Gunnison Sage-Grouse populations as well as the two described subspecies of Greater Sage-Grouse. In addition, the data provide information to help understand gene flow, genetic diversity, and evolutionary history between many additional populations. Collecting the same data across the entire species range made it possible to make comparisons between all surveyed populations. This will help managers develop species-wide management strategies that take genetic distinctiveness into account based in part upon the entire "genetic landscape" of the species.

**Bat conservation.** Three species of nectar- and pollen-feeding bats are unique to the southwestern U.S. and may be critical to the health and maintenance of ecosystems in the U.S./Mexico borderland area. The lesser long-nosed bat and greater long-nosed bat are endangered; the Mexican long-tongued bat is noted by some as being of concern. All three species may be jeopardized by vandalism and destruction of roosting sites, killing by humans,





and loss of habitat and food resources. Researchers from FORT's Arid Lands Field Station, located on the University of New Mexico campus, are studying the distribution, abundance, and activity patterns of the two species of long-nosed bats in New Mexico. The Bureau of Land Management, which is funding the study, needs updated information on the bats as a part of their conservation activities in southwestern New Mexico. Of considerable interest is the recent discovery of a significant new roost on BLM lands, 30 km northeast of the nearest previously known roost. This roost contains the largest aggregation of these bats found to date in New Mexico.

**Plague, fleas, and black-footed ferret recovery.** The federally endangered black-footed ferret, on the rebound from near-extinction, still faces serious recovery obstacles. One of them, sylvatic plague, is found in the prairie dog colonies upon which the ferrets depend. Eliminating plague from prairie dog colonies is essential for ferret recovery, so researchers at FORT have been testing two approaches. One involves testing vaccines developed by the Wildlife Health Research Center and Centers for Disease Control against plague for both of these animals. Oral vaccine for prairie dogs has shown promise in experimental studies, and a successfully tested injectable vaccine has been undergoing field trials on ferrets released in the wild. A second approach involves eliminating or reducing the incidence of plague from test areas by reducing the population of fleas that transmit the disease. Scientists are assessing the efficacy and cost of a flea control dust within burrows and are measuring the responses of prairie dog and other associated mammal populations. Recently, the information and experience gained from these studies was put to the test in South Dakota, where plague was recently discovered within 25 miles of the most successful and flourishing ferret reintroduction recovery site. In an effort to ward off the potentially disastrous consequences of losing this significant population, FORT scientists have teamed up with the FWS and other federal and state agencies to conduct emergency dusting of prairie dog burrows and vaccination and/or removal of black-footed ferrets to other reintroduction sites throughout the West to ensure their continued survival.



**Goal 2. Provide tools and techniques, such as predictive models, decision support, and expert systems, for science-based management of wildlife and plant populations and their habitats.**

**Advancing migratory bird conservation and management by using radar: an interagency collaboration.** Through a cooperative agreement, scientists from FORT and the University of Southern Mississippi recently initiated a collaborative study with FWS using Doppler weather radar to understand bird migration patterns in the borderlands of the arid Southwest (Brownsville, TX to San Diego, CA). The project will look at (1) migrant densities during flight, (2) migrant-habitat associations, (3) migrant flight elevation and direction of

travel, and (4) the effects of topographic obstruction (e.g., mountains) on radar capabilities.

Additionally, recognizing that efforts to advance bird conservation and management through the use of radar recently arose independently through several USGS/USFWS collaborations, FORT scientists led the development of a coalition of scientists and resource managers to foster a



coordinated approach to radar-related research and software development. The long-term focus of this coalition is to use radar technologies to better understand movement patterns and habitat associations of migratory birds and other wildlife. This information will be valuable to resource managers and others for habitat protection and management, as well as for addressing issues related to the siting and permitting of communication towers and wind power turbines that pose hazards to birds in flight. A fact sheet and open file report describing how radar can be used to study movements and habitat use patterns of wildlife were completed by the coalition.

## Products

During FY05, FORT scientists delivered more than 140 products, 123 of which were publications, not counting a number that are in press. A complete listing of FY05 products is provided in Appendix I.

## NEW INITIATIVES

Two major cooperative projects had their genesis in FY05:

### Invasive Species Operational Systems Support (NASA)

The National Institute of Invasive Species Science (Institute) is a recently established, USGS-led consortium of governmental and non-governmental partners whose aim is to provide reliable information and advanced decision support tools for documenting, understanding, predicting, assessing, and addressing the threat of invasive species in the U.S. The Institute was created in response to high-priority needs for invasive species research and management identified by USGS and Department of Interior clients (such as the National Park Service, U.S. Fish and Wildlife Service National Refuge System, Bureau of Land Management, and Bureau of Reclamation), other land management agencies, tribes, state and local governments, and the public.

The Institute incorporates NASA observations and predictive models to fulfill its mission and has a lead role in developing, testing, and deploying NASA-derived Earth observations and landscape-scale predictive modeling capabilities for the invasive species community. In addition, the Institute is working with NASA to develop a state-of-the-art Invasive Species Forecasting System (ISFS), which

will enhance USGS decision support by integrating high-performance modeling and satellite capabilities into the Institute's activities.

FORT is actively engaged in planning for the delivery of ISFS from NASA to the USGS and for its deployment into operational use no later than September 30, 2007. The transition plan defines (1) the ISFS to-be-delivered system, its deployment requirements, its operational requirements, and its requirements for enterprise sustainability; (2) the role that the ISFS plays in the Institute's activities and Early Detection/Rapid Response (ED/RR); and (3) recommended steps that USGS must take to successfully move the ISFS into operational use and make the Institute, the ISFS, and USGS's ED/RR program sustainable resources for the Nation.



ISFS will become a unique resource of the USGS Fort Collins Science Center and its National Institute of Invasive Species Science. The system is the result of a six-year, \$8.5M collaboration with NASA

aimed at enhancing USGS's invasive species decision support by applying NASA's engineering, high-performance computing, and remote sensing expertise. The ISFS is becoming the basis for a new information services "line-of-business" for FORT and the Institute by providing the means for delivering advanced decision support products to ED/RR and other advanced modeling and forecasting applications of importance to other federal agencies and stakeholders.

## Sage Habitat Studies

Sagebrush ecosystems are diverse habitats found throughout western North American that support a variety of flora and fauna. Home to unique wildlife such as Sage-Grouse, Sage Thrashers, Brewer's Sparrows, Ferruginous Hawks, and pygmy rabbits, these ecosystems have undergone intense changes since the time when millions of bison roamed the plains. European settlement and intense agricultural practices resulted in the loss of over half of the sagebrush ecosystem. Today, sagebrush habitats continue to be threatened by a variety of influences. Conversion of these native landscapes to agriculture, invasion by non-native plant species, energy extraction activities and associated developments, rural expansion, and intense grazing pressures can all reduce, degrade, or fragment remaining habitat.

To conserve these valuable ecosystems, land and resource managers need a solid understanding of the functioning of these systems and the influence that human developments may have on sagebrush-dependent species. Research addressing these issues will provide managers with tools and information to balance future human uses with conservation of sagebrush habitat and obligate species, and greatly assist managers in providing high-quality habitat for wildlife.



A sagebrush research group comprising scientists from FORT, the USGS Forest and Range Ecosystem Science Center, and Colorado State University is carrying out this important work on sagebrush habitat conservation issues. The team is working with Bureau of Land Management, National Park Service, and U.S. Fish and Wildlife Service National Wildlife Refuge managers and biologists to prioritize management needs for imperiled sagebrush ecosystems. Scientists are identifying important wildlife-habitat relationships as well as thresholds for industrial development and human activities that will ensure the persistence of wildlife species of special concern.

#### **4 C's PHILOSOPHY—BUILDING COLLABORATION AND PARTNERSHIPS**

Secretary of Interior Gale Norton has advanced a philosophy of Conservation through Cooperation, Communication, and Consultation: the 4 C's. It signifies the Department's emphasis--and that of its bureaus, including USGS—on cooperation via partnerships and collaborative work, and the commitment to work in concert with all partners to attain common conservation goals. FORT embraces this philosophy and practices it daily with its many partners and customers through ongoing projects, workshops, and new, customer-driven science directions. Major examples from FY05 follow.

#### **Workshops**

On April 6-8, 2005, USGS Brown Treesnake Project (BTS) staff attended the spring 2005 **Brown Treesnake Technical Committee Meeting** held in Honolulu, Hawaii. Over 100 stakeholders representing more than a dozen federal, state and territory agencies and organizations attended the meeting. The meeting provided stakeholders an update of agency and individual research, management, and public education activities, as well as a forum for interagency efforts to update the 1996 BTS Control Plan and address BTS-related budgetary issues.

**Negotiations training.** Natural resource biologists and managers continually need access to new knowledge, skills, and technologies in their efforts to protect and enhance our Nation's resources. The Policy Analysis and Science Assistance Branch conducts three courses each year at FORT, two on Basic Natural Resource Negotiation Training and one on Advanced Natural Resource Negotiation Training. These training courses provide participants with the principles, skills, and techniques used in natural resource negotiation. In October, at the request of Seattle City Light, FORT also conducted the basic course on site in Seattle for SCL's negotiation team.

**Institutional Analysis Workshop.** The workshop was held on 28-29 January at FORT. Sponsors included FORT, the USGS Science Impact Program, the Colorado State University Department of Political Science, and the Faculty of Engineering, Yamaguchi University (Japan). Thirty-five scholars and practitioners attended. The workshop was designed to advance social science theory and methods, and to improve practical applications for managers and planning teams.

**Workshop for Instream Flow: Habitat/Population Estimates.** This 3-day workshop, held on March 23-25, was attended by 25 individuals, including representatives from Electricite de France and CEMEGREF in France, and Fisheries and Oceans in Canada. The workshop was intended to find ways to increase certainty in the decision-making process relating to flow



regimes and aquatic resource management. To that end a template for study design was developed and a central repository for information identified. The template will aid in designing studies to detect biological responses to new flow regimes over long periods of time.

On June 6-11, 2005, Tom Stohlgren and Catherine Jarnevič convened the **USGS-NASA Science Team Meeting** that included USGS and other DOI scientists, NBII, NASA researchers, and University scientists (70 people total). The objective was to demonstrate invasive species forecasting capabilities for resource management and demonstrate field techniques for capturing information on tamarisk locations to improve models for management.

## New Science Directions

**Bureau of Reclamation employee satisfaction.** A new reimbursable task at FORT for Policy Analysis and Science Assistance Branch was funded by Reclamation and the USGS Status and Trends of Biological Resources Program. The goal of the Bureau of Reclamation Employee Satisfaction Survey was to gather organizational-relevant feedback from employees on customer relations, delivery of services, effectiveness of external and internal communication, and satisfaction with the Reclamation work environment.

**Workshop for instream flow: Habitat/population estimates.** A new reimbursable task at FORT for Policy Analysis and Science Assistance Branch (PASA) was funded by the USDA-Forest Service. See Workshops, immediately above, for more.

**Research support in FWS.** A new task for the Policy Analysis and Science Assistance Branch was funded by the U.S. Fish and Wildlife Service and Fish and Wildlife Service Science Support Program. The need to understand the current research capacity of the FWS prompted an organizational assessment of the agency. A three-part study was funded to analyze the quality, quantity, and support for research in the FWS. See page 9 for more.

**Distribution survey of meadow jumping mice (*Zapus hudsonius*) subspecies in eastern Wyoming, western South Dakota, and southeastern Montana.** Results of a recent taxonomic study on subspecies of the meadow jumping mouse (1) suggest that Preble's meadow jumping mouse (*Z. h. preblei*) is not a valid subspecies (Ramey et al. 2004). This study indicated that the subspecies currently named *Z. h. preblei*, known to occur only in Colorado and southern Wyoming, is actually a subpopulation of *Z. h. campestris*, which occurs in the Black Hills region of northeastern Wyoming, western South Dakota, and southeastern Montana. At the request of the U.S. Fish and Wildlife Service, FORT scientists are conducting field work to document the distribution and occurrence of subspecies of the meadow jumping mouse on the northern Great Plains, with a primary focus on collecting samples for a comprehensive genetic analysis being conducted by the USGS Leetown Science Center.

**Bird migration patterns in the arid Southwest.** Understanding avian migratory patterns and how migrants use specific habitats during stopover is valuable to any avian conservation plan that identifies habitats important to migrants across all phases of their life cycle—breeding, brood-rearing, wintering, and migration. In addition to natural challenges birds face during migration (e.g., high energy demands, competition, predation, severe weather), anthropogenic threats during migration include habitat loss or degradation, hazardous structures such as communication towers and wind power turbines, and global climate change. A particular need is determining bird



migration patterns in the desert Southwest where western migrants cross inhospitable, arid landscapes between breeding and wintering grounds. At the request of the FWS, FORT scientist Janet Ruth and University of Southern Mississippi collaborators will use data from digital Doppler weather surveillance radar (known as NEXRAD, for NEXt generation RADar) to investigate how migrants use riparian habitats for refueling during migration. Researchers will examine how variation in broad migratory patterns across the Southwest influences migrant density or abundance at stopover sites, and how use of riparian habitats compares with use of grassland, desert, shrubland, mesquite bosque, or montane habitats during migratory stopovers. Dr. Ruth and collaborators will also be obtaining information on migrant flight altitude distributions, directions of travel, and how all these patterns vary seasonally and annually. This information may be particularly valuable to USFWS and other landowners for resource conservation (habitat protection, enhancement, and acquisition) and regulatory activities, especially two issues of recent concern: the siting and permitting of communication towers and wind power turbines, known to cause bird mortality.

**Using genetic tools to provide insight into colony dynamics of the endangered Indiana bat.**

The need for accurate demographic and relatedness information has been identified as a high-priority need for the management and recovery of the Indiana bat. At the request of the U.S. Fish and Wildlife Service, FORT scientist Sara Oyler-McCance, in collaboration with scientists from Indiana State University, is developing molecular genetic markers and optimizing DNA extraction techniques. The goal is to assess the feasibility of using of DNA collected from Indiana bat feces to uniquely identify individual bats in order to investigate genetic relatedness and—for mark-recapture studies—to estimate survival rates and population sizes.



**Determining live-capture methods and techniques for migrating and staging Marbled Godwits.** The Marbled Godwit was chosen by a team of representatives from the USGS, U.S. Fish and Wildlife Service, University of Montana, Canadian Wildlife Service, and Mexico (PRONATURA) as the focus for a recently initiated international shorebird conservation effort, the Tri-National Marbled Godwit Initiative. This initiative aims to take a large-scale view in developing a hemispheric conservation plan for this species. Relatively little is known about Marbled Godwits during migration, especially the key stopover sites used during both spring and fall migration. Devising an effective live-capture method for Marbled Godwits while they are concentrated at migration stopover sites would allow for capturing and subsequent data collection and marking of large population segments of the species. As a first step, FORT scientist Adrian Farmer is conducting field research to determine the most efficient and least stressful live capture method(s) for Marbled Godwits. This will allow future research to fill in information gaps on Marbled Godwit physiology and migration ecology such as length of stay, weight gain, habitat usage, and migration pathways, and genetic analysis will be used to determine sub-populations.

**Ecology of the occult myotis (*myotis occultus*): Investigating diet, ectoparasites, distribution, and morphological variation.** Throughout history, the taxonomic status of the bat *Myotis occultus* has undergone multiple changes. Since 1907, it has been classified as a distinct species, a subspecies of another bat species, and most recently (and once again) as a distinct species. Although now recognized as a distinct species, little is known about the ecology of *M. occultus* in the Southwest. Using the clade and subclade groupings of *M. occultus* in New Mexico as a “map,” FORT scientist Ernest Valdez is examining historic and new specimens to determine if there are associated patterns with morphology, diet, and ectoparasites. Understanding diet of insectivorous bats will provide better understanding on impacts to agricultural pests as well as pest species on southwestern forests. Also, understanding the diversity of ectoparasites occurring on bat species can provide insight on possible zoonotic diseases and possible impacts on rates of transmission to humans. Moreover, understanding systematic relationships between host and parasite can reveal insights on ecological changes over time.

**Grass buffers for wetlands in agricultural landscapes: A literature synthesis.**

Restoration practices for wetlands within agricultural settings often include grass buffers. Management objectives for these buffers generally are to prevent sediments, contaminants, and excess nutrients from reaching the wetland and to provide wildlife habitat. Currently, there are no studies that address playa buffer criteria or effectiveness relative to management objectives. Factors that may affect playa buffer effectiveness are complex and include land use, soil texture, slope and size of the playa watershed, buffer vegetation species and structure, buffer size/width, and buffer use. At the request of the Playa Lakes Joint Venture, FORT scientists Susan Skagen and Cynthia Melcher summarized current knowledge about grass buffers for protecting small, isolated wetlands in agricultural contexts, including information relevant to protecting playas from runoff containing sediments, nutrients, pesticides, and other contaminants, and information on how buffers affect densities and productivity of grassland birds. They also identified that future research should entail multiple-scale approaches at regional, wetland-complex, and individual watershed scales. Information needs include direct measures of buffer effectiveness in “real-world” systems, refinement and field testing of buffer-effectiveness models, and basic ecological information on playa function and playa wildlife ecology. Understanding how wildlife communities respond to patch size and habitat fragmentation is crucial for addressing questions regarding the habitat quality of grass buffers in playa systems.

**Estimating salmon production response to altered temperature in the Sacramento River, California.** The U.S. Bureau of Reclamation needs to evaluate the effects of a proposed raising of Shasta Dam on downstream salmonid populations in the Sacramento River, California. In previous work, FORT applied an existing salmon production model in the Sacramento River between Keswick Dam and Battle Creek (Bartholow 2003). This model, SALMOD, computes the effects of a time series of flow and water temperature on growth and survival of Chinook salmon. It is proposed that this modeling work be extended further downstream to near Red Bluff, using newly available habitat descriptions and quantification. The revised model would use simulated flows and temperatures reflecting potential reservoir operations that would accompany the raising of Shasta dam. These simulated flows and water temperatures would come from models being put in place by Reclamation staff.

**Hydrologic classification of Missouri streams.** The Hydrologic Assessment Tool (HAT) is a Windows-based application that imports USGS gage station data on daily and peak flows, and computes 171 indices that address five flow components: magnitude, frequency, duration, timing,

and rate of change. Various output reports and graphs can be used to establish a hydrologic baseline time period, evaluate past and proposed hydrologic alterations, and establish environmental flow standards and recommendations. A state-specific classification and version of the software is being developed for the Missouri Department of Conservation and the FWS.

**Tamarisk and native plant response to streamflow.** As part of the Biological Invasions Project, a new subtask, *Streamflow Management to Inhibit Tamarisk Regeneration and Favor Native Vegetation Regeneration*, was initiated. Objectives of this task are to conduct case studies of the response of tamarisk and native species (e.g., cottonwood, willow) to managed streamflows on the Bill Williams River (Arizona) and Green River (Utah); and evaluate responses in the context of existing conceptual and quantitative models.

**Road impacts on water.** Under the DOI Rapid Response Project, a new task, *Baca National Wildlife Refuge Hydrology*, was started. The task entails using existing data to assess road impacts on surface and shallow aquifer hydrology and also address the impact of roads and other water management practices on Refuge lands.

**Riparian Monitoring Protocols.** This task started in FY05 as part of the Riparian Ecology Project. This task will help the NPS describe current riparian vegetation composition and structure, relative to the dominant fluvial geomorphic processes, found within a wide range of stream types within northern and southern Colorado Plateau Network parks. It also will assess the effects of water and land management activities.

**Modeling ecosystem response to atmospheric deposition.** Under an existing task, entitled *Ecological Effects of Nitrogen and Sulfur Deposition*, a new agreement was signed with the EPA, *Assessing Ecological and Biogeochemical Responses to Changing Atmospheric Nitrogen and Sulfur Deposition at Local to Regional Scales in the U.S.* This effort will evaluate the effectiveness of various models in assessing the response of ecosystems to N and S deposition at local to regional scales and assess consequences of changing atmospheric deposition on ecosystems.

**Ecology of height release of willow thickets following wolf reintroduction (NRPP).** The purpose of this investigation is to determine the extent and characteristics of the apparent height release of willows across the northern range of Yellowstone National Park since the restoration of wolves in 1995.

**Aspen ecology in the core elk range of Rocky Mountain NP (NRPP).** This work will determine conditions that allowed aspen to establish in the core winter range of elk in RMNP and provide information on how fire, climate, and estimated elk densities interact with and influence potential future aspen regeneration.

**Elk and bison grazing ecology and management in Great Sand Dunes National Park and Preserve.** Objectives of this work include determining the current population status, year-round distribution, and movements of elk. We are also assessing the ecosystem effects of grazing by elk, bison, and cattle to help the Park, The Nature Conservancy, and private landowners in evaluating management options.

**Effects of roads and land management practices on wildlife behavior.** The objective of this task is to provide the research basis for using traffic management as an indirect tool for wildlife management by simultaneously observing patterns of human traffic and animal movements.

**Effects of elk herbivory on alpine plant communities in the elk summer range of Rocky Mountain National Park, Colorado: An analysis of existing data.** This work will investigate trends in plant cover, heights, species composition, and ungulate-days use over the 25-year period from 1968-1992.

**Research in sagebrush ecosystems.** Several new activities will be collected under a new Sagebrush Ecosystems Project in FY06. They include (1) new collaborative work with FRESC and BLM on the *Wyoming Basin Ecoregional Assessment*; (2) work on grazing and prescribed burning on plants and soils in a high-elevation, sagebrush-steppe ecosystem in Wyoming through BLM Applications of Science; (3) a literature review task titled *Environmental Effects of Off-Highway Vehicles on Bureau of Land Management Lands*; and (4) a collaborative task with BLM, FRESC, and the GIO to identify and classify sagebrush ecosystems information on the internet and improve availability of USGS resources.

### **Progress and Accomplishments in Major Collaborative Ventures and Partnerships**

**Science-based flow recommendations.** FORT riparian ecologists are providing scientific leadership in working with over 50 stakeholders to develop a unified flow recommendation for the Bill Williams River in Arizona. The operations of Alamo Dam on the Bill Williams River are being revised to include downstream values other than the traditional irrigation and municipal water delivery, and power generation. FORT ecologist Pat Shafroth is leading a diverse group of scientists and managers to help provide a scientific basis for decisions on flows that will meet multiple natural resource objectives. Previous work on this project has documented the effects of Alamo Dam operations on fluvial geomorphology and riparian vegetation along the river. The work was complex and interdisciplinary, including linkages between streamflow, fluvial processes, groundwater hydrology, and riparian vegetation at multiple spatial and temporal scales. As a result of this collaborative work, the U.S. Army Corps of Engineers and the Bureau of reclamation are conducting an adaptive management program using the unified flow recommendations.

**Tamarisk Suitability Map.** Colleagues at NASA Goddard Space Flight Center and FORT (Morissette, J., C. Crosier, J. Pedelty, A. Ullah, W. Cai, T. Stohlgren, J. Gentle, J. Schnase) combined expertise and resources to create "a tamarisk habitat suitability map for the continental USA." This demonstrated the tremendous value of (1) consolidating databases (rather than just pointing to them or linking to them), (2) integrating the data with remote sensing information (MODIS, in this case), and (3) using high-performance computing to develop predictive spatial models of invasion potential. This also demonstrated the power of the NASA-USGS Invasive Species Forecasting System and the Global Organism Detection and Monitoring System. These capabilities and information they produce are essential building blocks for local-, regional-, and national ED/RR programs.

### **Lake Havasu Fishery Enhancement.**

A Memorandum of Understanding (MOU) has been developed to implement the multi-agency Lake Havasu Fishery Enhancement Program. The Central and Western Regions will be MOU signatories with other members that include the Bureau of Land Management, Bureau of Reclamation, U.S. Fish and Wildlife Service, Arizona Department of Game and Fish, and California Fish and Game Department. The purpose of the group is to oversee and make recommendations on the Lake Havasu Fishery Enhancement Program. The MOU is currently being signed by the member agencies.



**Endangered Colorado River Fish Restoration and Recovery.** FORT fisheries biologists continued working with federal, state, tribal, and private parties in the creation of a system of small native fish sanctuaries to restore threatened and endangered fish species. A more detailed description of this work is provided on page 4.

**Support to FWS for Klamath River FERC Relicensing.** FORT scientists continued working with the Office of the Secretary of the Interior, the Office of the Solicitor, BIA, FWS, BOR, BLM, NPS, and PacifiCorp in the Klamath Basin, Oregon and California, toward a Federal Energy Regulatory Commission (FERC) relicensing of hydropower facilities in the middle river basin. In FY05, FORT scientists used the Systems Impact Assessment Model (SIAM) to analyze several flow alternatives for the U.S. Fish and Wildlife Service. A more detailed description is provided on page 5.

**Plague, fleas, and black-footed ferret recovery.** Eliminating sylvatic plague from prairie dog colonies is essential for endangered black-footed ferret recovery, so researchers at FORT have been testing two approaches. One involves testing vaccines developed by the Wildlife Health Research Center and Centers for Disease Control against plague for both of these animals. Oral vaccine for prairie dogs has shown promise in experimental studies, and a successfully tested injectable vaccine has been undergoing field trials on ferrets released in the wild. A second approach involves eliminating or reducing the incidence of plague from test areas by reducing the population of fleas that transmit the disease. Scientists are assessing the efficacy and cost of a flea control dust within burrows and are measuring the responses of prairie dog and other associated mammal populations. Recently, the information and experience gained from these studies was put to the test in South Dakota, where plague was recently discovered within 25 miles of the most successful and flourishing ferret reintroduction recovery site. In an effort to ward off the potentially disastrous consequences of losing this significant population, FORT scientists have teamed up with the FWS and other federal and state agencies to conduct emergency dusting of prairie dog burrows and vaccination and/or removal of black-footed ferrets to other reintroduction sites throughout the West to ensure their continued survival.



## Other Partnerships and Collaborations

FORT enjoys strong working relationships with DOI agencies (BLM, USFWS, NPS, BOR) and the Office of Insular Affairs. Additional Federal agency partners include NASA, USDA (Agricultural Research Service, Farm Service Agency, APHIS, U.S. Forest Service), EPA, the Department of



Defense, and U.S. Army Corps of Engineers. Non-federal partners include state and local agencies, Native American tribes, private consultants, international organizations and agencies, non-profit organizations, and universities. FORT is a partner in several large regional and national partnerships, such as the National Science Foundation's NEON program, the National Biological Information Infrastructure, and the National Institute of Invasive Species Science (which FORT leads). Major collaborations are described under *Center Accomplishments and Progress and Accomplishments in Major Collaborative Ventures and Partnerships*, above.

In addition, FORT scientists served in leadership roles and accepted committee assignments for numerous regional and national organizations and partnerships, and were asked to present at various workshops and meetings. A select list of staff appointments and committee assignments as well as invited speaking engagements is provided in Appendix 2.

## INTEGRATED SCIENCE

Integrated science is the USGS way of doing business. Because few natural resource problems are limited to only one discipline, the Biological Resources, Geography, Geology, and Water Resources disciplines cooperate on projects that involve landscape components and well as the life they support. Following are some of the successful interdisciplinary projects with which FORT scientists are engaged.

### Projects and Tasks

**Central Region Integrated Science Project (CRISP).** FORT staff continued collaboration on the CRISP project, "Numerical simulation of the cumulative effects of land-use change and aggregate mines on ground-water flow and wetlands along the South Platte River, Brighton to Fort Lupton, Colorado." To date, aerial photography and ground truthing have been used to identify existing wetlands, and groundwater simulation results have been interpreted to evaluate impacts of groundwater-level changes on those wetlands.

**Forecasting Habitat Health on the Upper Delaware River.** FORT scientists continue working with USGS-WRD on the Delaware River flow study. A full description of this work is provided on page 4.

**Upper Klamath Basin Integrated Science Project.** USGS, as part of the Integrated Science Project in the Upper Klamath Basin, is collaborating with the Klamath Basin Rangeland Trust to evaluate the data collected and develop a land-use model for the Wood River Valley that can be used by resource managers and land owners to plan, develop, and implement best management practices to reduce nutrient loading to Upper Klamath Lake. See page 5 for a more complete description of this work.

**Development of the Hydroecological Integrity Assessment Process (HIP).** The Hydroecological Integrity Assessment Process (HIP) is being developed as a joint project between the USGS New Jersey Water Science Center, FORT, and the New Jersey Department of Environmental Protection. HIP involves three major steps: (1) a hydrologic classification of streams (using 171 indices) for a geographic area (state) to identify statistically significant, non-redundant, hydroecologically relevant indices associated with the five major flow components (a total of 10 sub-components) for each stream class; (2) development of a stream classification program for placing streams not used in the classification analysis into one of the identified stream classes; and (3) development of a hydrologic assessment program used to establish a hydrologic baseline, environmental flow standards, and evaluate past and proposed hydrologic modifications for a stream reach. HIP is intended for use by any federal or state agency, institution, private firm, or non-government entity that has a responsibility or interest in the management and/or regulation of streams, with an objective to address ecological integrity at the reach or watershed scale. In addition, HIP can assist researchers by identifying critical, stream class specific, hydrologic indices that adequately characterize the five major components of the flow regime (magnitude, frequency, duration, timing, and rate of change) using 10 non-redundant indices.

**Stable isotopes and bird migration.** FORT scientist Adrian Farmer and doctoral candidate Mike Wunder (Project Officer Fritz Knopf) continue to work with Bob Rye, Gary Landis, Cynthia Kester, and Carl Bern of the Geologic Division's Stable Isotope Lab in Denver on the use of stable isotope technology for predicting a bird's location at time of molt at a coarse spatial scale.

**ARMI.** FORT scientist Erin Muths continues to collaborate with Don Campbell (USGS-WRD) on the collection of water samples at amphibian sites for the USGS Amphibian Research and Monitoring Initiative.

**Chytrid fungus test.** As part of the competitively funded project "Developing a method of environmental testing for chytrid fungus (*Batrachochytrium dendrobatidis*) from amphibian habitats using Polymerase Chain Reaction (PCR)," (Chauncey Anderson, Hydrologist, USGS-WRD, Portland, OR), FORT scientist Erin Muths assisted in sample collection in Rocky Mountain National Park during summer 2005.

**Sagebrush ecosystems (Central Region Integrated Science Projects [CRISP]).** Two tasks focusing on BLM management needs in sagebrush ecosystems were initiated as part of CRISP in FY05. The first is "Mapping sagebrush habitats in human-influenced landscapes: A case study in the Jack Morrow Hills/Pinedale Area to develop quality data resources for BLM land-use management and planning." This work will (1) assess and map the distribution of roads, trails, and oil and gas infrastructure and (2) develop, assess, and compare the accuracies of several remote sensing methodologies in identifying and mapping sagebrush at a large landscape scale. The second study, "Quantifying the physical impacts of re-enacted Mormon handcart trekking across the historic Oregon/Mormon pioneer/California/pony express national historic trail corridor: An

aerial photography approach to assess impacts and develop use thresholds in Wyoming,” will provide the scientific foundation to help BLM develop management guidelines describing potential future impacts to the historic trail based on the number and types of users along that trail. That is, researchers will derive “thresholds of use” above which alteration of the trail from its “native” or historic state will occur at various measured intensities.

**Atmospheric deposition and biogeochemical processes.** FORT ecologists are working with other USGS disciplines, the EPA, NPS, and USDA-FS to assess ecological and biogeochemical responses to changing atmospheric nitrogen (N) and sulphur (S) deposition at local to regional scales. N and S inputs cause complex responses in ecosystems including fertilization, forest ecosystem decline, lake and stream eutrophication and acidification, loss of soil base cations, and alterations of disturbance regimes. This study is refining, testing, and applying ecological process models to diverse ecosystems across the U.S. to better understand biogeochemical processes related to atmospheric deposition, forecast responses to changing atmospheric deposition, and assist in the formulation and evaluation of new, innovative ecosystem approaches and benchmarks.

## APPENDIX I. FORT FY2005 PUBLICATIONS AND PRODUCTS

### FORT Publications Delivered in FY2005

Publication Type	Program	Goal	Citation
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**Biological Informatics #1 - Identify and prioritize the content required to inform the interests of our customers and provide access to the high priority content.**

USGS Series	BIO	I	U.S. Geological Survey. 2004. Fort Collins Science Center. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Fact Sheet 2004-3146. 2 p.
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**Fisheries: Aquatic and Endangered Resources #1 - Provide scientific information about the diversity, life history and species interactions that affect the condition and dynamics of aquatic communities.**

Proceedings	FAER	I	Mueller, G., and T. Burke. 2005. Survival of young razorback sucker in relation to stocking rates (fish/ha) and in the presence or absence of predator communities in Lake Mohave, Arizona-Nevada. In: Brouder, M.J., C.L. Spring, and S.C. Leon, (eds.). Proceedings from two symposia: Restoring native fish to the lower Colorado River: interactions of native and non-native fish and Restoring natural function within a modified riverine environment: the low. Albuquerque, NM: US Fish & Wildlife Service, Southwest Region. p. 155-163.
USGS Series	FAER	I	U.S. Geological Survey. 2004. Fort Collins Science Center: Aquatic Systems and Technology Applications. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Fact Sheet 2004-3149. 2 p.
Journal Article	FAER	I	Carpenter, J. 2005. Competition for food between an introduced crayfish and two fishes endemic to the Colorado River basin. Environmental Biology of Fishes 72: 335-342.
USGS Series	FAER	I	Mueller, G.A., J. Carpenter, and P.C. Marsh. 2005. Cibola High Levee Pond annual report 2004. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Open-File Report 2005-1075. 46 p.

**Fisheries: Aquatic and Endangered Resources #2 - Provide scientific information about factors and processes that affect aquatic organism health in support of survival, protection, conservation and recovery.**

Journal Article	FAER	2	Bartholow, J.M. 2005. Recent water temperature trends in the Lower Klamath River, California. North American Journal of Fisheries Management 25: 152-162.
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Publication Type	Program	Goal	Citation
Abstract	FAER	2	Bartholow, J.M. 2004. Detecting trends in water temperatures in the Lower Klamath River, California [abs.]. In: The first National Conference on Ecosystem Restoration (NCER): Sustainable ecosystem restoration through integration of science, planning and policy, December 6-10, 2004, Lake Buena Vista, FL. Lake Buena Vista, FL: Ecosystems Restoration Conference. p. 23.
Abstract	FAER	2	Bartholow, J.M., S.G. Campbell, and M. Flug. 2004. Quantifying the effect of dam removal on water temperatures in the lower Klamath River, California, and implications for salmon recovery [abs.]. In: The first National Conference on Ecosystem Restoration (NCER): Sustainable ecosystem restoration through integration of science, planning and policy, December 6-10, 2004, Lake Buena Vista, FL. Lake Buena Vista, FL: Ecosystem Restoration Conference. p. 24.
Proceedings	FAER	2	Milhous, R.T. 2004. Physical habitat and sediment in the lower Virgin River. In: Sehlke, G., D. Hayes, and D.K. Stevens, (eds.). Critical transitions in water and environmental resources management. Proceedings of the World Water and Environmental Resources congress 2004, June 27-July 1, 2004, Salt Lake City, UT . Reston, VA: American Society of Civil Engineers. p. [1-10] CD-ROM.
Journal Article	FAER	2	Bartholow, J.M., S.G. Campbell, and M. Flug. 2004. Predicting the thermal effects of dam removal on the Klamath River. Environmental Management 34(6): 856-874.

**Fisheries: Aquatic and Endangered Resources #3 - Quantify and describe functional relationships among aquatic species and habitats to provide information to conserve or restore aquatic community structure and function.**

Journal Article	FAER	3	Mueller, G.A., and M.J. Horn. 2004. Distribution and abundance of pelagic fish in Lake Powell, Utah, and Lake Mead, Arizona-Nevada. Western North American Naturalist 64(3): 306-311.
Proceedings	FAER	3	Terrell, J.W., K.G. Thompson, and D. Winkelman. 2005. Tubifex limiting factors based on wet sieve analysis of core samples. In: Proceedings: 11th annual Whirling Disease symposium: "recipes for recovery", February 3-4, 2005, Denver, Colorado. Bozeman, MT: Whirling Disease Foundation. p. 15-16.
Journal Article	FAER	3	Milhous, R.T. 2004. Mixing physical habitat and streamflow time series analysis. Hydroecologie Appliquee 14(1): 69-91.
Abstract	FAER	3	Milhous, R.T. 2005. Time series analysis and the analysis of riverine ecosystems [abs.]. In: Proceedings: VIIth IAHS Scientific Assembly. Freshwater: Sustainability within Uncertainty. Foz do Iguaçu, Brazil. 3-9 April 2005. Foz do Iguaçu (Brazil): IAHS. p. CD.



Publication Type	Program	Goal	Citation
Journal Article	FAER	3, 4	Bartholow, J.M. 2004. Modeling chinook salmon with SALMOD on the Sacramento River, California. <i>Hydroecologie Appliquee</i> 14(1): 193-219.

**Fisheries: Aquatic and Endangered Resources #5 - Develop research and technology tools to provide the scientific basis for developing adaptive management strategies and evaluating their effectiveness for restoration efforts to sustain aquatic resources.**

Journal Article	FAER	5	Flug, M., and S.G. Campbell. 2005. Drought allocations using the Systems Impact Assessment Model: Klamath River. <i>Journal of Water Resources Planning and Management</i> 131(2): 110-115.
Abstract	FAER	5	Flug, M. 2004. Restoration of western river ecosystems: reality or rigormortis? [abs.]. In: The first National Conference on Ecosystem Restoration (NCER): Sustainable ecosystem restoration through integration of science, planning and policy, December 6-10, 2004, Lake Buena Vista, FL. Lake Buena Vista, FL: Ecosystem Restoration Conference. p. 137.
USGS Series	FAER	5	Auble, G.T., Z.H. Bowen, K.D. Bovee, A.H. Farmer, N.R. Sexton, and T.J. Waddle. 2004. Summary of studies supporting cumulative effects analysis of Upper Yellowstone River channel modifications. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Open-File Report 2004-1442. 60 p.
Abstract	FAER	5	Bovee, K.D. 2005. Applying concepts of landscape ecology to rivers [abs.]. In: USGS workshop: linking hydrological change and ecological response in streams and rivers of the eastern United States, February 8-10, 2005, Herndon, VA. Herndon, VA: U.S. Geological Survey. p. 1.
USGS Series	FAER	5	Bartholow, J.M., J. Heasley, R.B. Hanna, J. Sandelin, M. Flug, S. Campbell, J. Henriksen, and A. Douglas. Evaluating water management strategies with the Systems Impact Assessment Model: SIAM Version 4. Revised March 2005. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Open-File Report 03-82 (web-based). 133 p.

**Fisheries: Aquatic and Endangered Resources #6 - Provide research support and technical assistance to DOI bureaus, other Federal and State government agencies, Tribes, and non-governmental groups to support natural resource management problem solving and decision making.**

Proceedings	FAER	6	Bovee, K.D., T.J. Waddle, and R.B. Jacobson. 2004. Quantification of habitat patch persistence in rivers affected by hydropowering. In: Lanfear, K.J., and D.R. Maidment, (eds.). AWRA spring specialty conference: GIS and water resources III, May 17-19, 2004, Nashville, TN. Nashville, TN: AWRA. p. 1-10.
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Publication Type	Program	Goal	Citation
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**Invasive Species #1 - Provide and coordinate the collection, synthesis, and accessibility of invasive species information (Information Management Goal)**

Journal Article	INV	I	Crosier, C.S., and T.J. Stohlgren. 2004. Improving biodiversity knowledge with dataset synergy: a case study of non-native plants in Colorado. <i>Weed Technology</i> 18: 1441-1444.
USGS Series	INV	I	U.S. Geological Survey. 2004. Fort Collins Science Center: Invasive Species Science. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Fact Sheet 2004-3145. 2 p.
Journal Article	INV	I	Savarie, P.J., W.S. Wood, G.H. Rodda, R.L. Bruggers, and R.M. Engeman. 2005. Effectiveness of methyl bromide as a cargo fumigant for brown treesnakes. <i>International Biodeterioration &amp; Biodegradation</i> 56: 40-44.

**Invasive Species #4 - Provide approaches to contain, reduce, and eliminate populations of invasive species and restore habitats and native species (Control and Management Goal)**

Abstract	INV	4	Auble, G.T., J.M. Friedman, M.L. Scott, P.B. Shafroth, M.F. Merigliano, M.D. Freehling, R.E. Evans, and E.R. Griffin. 2004. Abundance of woody riparian species in the western USA in relation to phenology, climate, and flow regime . <i>EOS Transactions, AGU Fall Meeting Supplement</i> , December 13-17, 2004, San Francisco, CA 85(47): B41A-0097.
Journal Article	INV	4	Friedman, J.M., G.T. Auble, P.B. Shafroth, M.L. Scott, M.F. Merigliano, M.D. Freehling, and E.R. Griffin. 2005. Dominance of non-native riparian trees in western USA. <i>Biological Invasions</i> 7: 747-751.
Journal Article	INV	4	Gaskin, J.F., and P.B. Shafroth. 2005. Hybridization of <i>Tamarix ramosissima</i> and <i>T. chinensis</i> (saltcedars) with <i>T. aphylla</i> (athel) (tamaricaceae) in the southwestern USA determined from DNA sequence data. <i>Madrono</i> 52: 1-10.

**Status and Trends of Biological Resources #1 - Provide a framework that facilitates the integration of information from a variety of sources at multiple spatial and temporal scales to describe and track the abundance, distribution, productivity, and health of the Nations plants, animals, and ecosystems.**

USGS Series	S&T	I	Waltermire, R.G., T. Fancher, and D.M. Schneider. 2004. Rapid Reponse Request for the U.S. Fish and Wildlife Service Ecological Services Field Offices in Lakewood and Grand Junction, Colorado. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. 21 p.
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<b>Publication Type</b>	<b>Program</b>	<b>Goal</b>	<b>Citation</b>
USGS Series	S&T	I	Cannon, S., G. Chong, S. Haire, C. Key, R. Kokaly, T. Kotliar, D. Martin, J. Moody, and J. Taylor. 2004. The ecological, hydrological, and geological consequences of burn severity and social application of those results. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. 24 p.
USGS Series	S&T	I	U.S. Geological Survey. 2004. Fort Collins Science Center: Policy Analysis and Science Assistance. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Fact Sheet 2004-3144. 2 p.
USGS Series	S&T	I	Skagen, S.K. 2005. Shorebird conservation in dispersed ephemeral wetland systems: recommended criteria for Western Hemisphere Shorebird Reserve Network (WHSRN) landscape sites. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. 7 p.

**Status and Trends of Biological Resources #2 - Develop and evaluate inventory and monitoring methods, protocols, experimental designs, analytic tools, models, and technologies to measure biological status and trends.**

Proceedings	S&T	2	Taylor, S.N., and J.G. Taylor. 2004. Wayfinding in human ecology. In: Camarda, I., M.J. Manfredo, F. Mulas, and T.L. Teel, (eds.). Global challenges of parks and protected area management: Proceedings of the 9th ISSRM, October 10-13, 2002, Sardinia, Italy. Sassari, Italy: Carlo Delfino editore, Via Rolando. p. 487-494.
Proceedings	S&T	2	Taylor, J.G., N.R. Sexton, P.D. Ponds, E. Shuster, and S.S. Harlow. 2004. Measuring experiences in parks and protected areas. In: Camarda, I., M.J. Manfredo, F. Mulas, and T.L. Teel, (eds.). Global challenges of parks and protected area management: Proceedings of the 9th ISSRM, October 10-13, 2002, Sardinia, Italy. Sassari, Italy: Carlo Delfino editore, Via Rolando. p. 479-485.
Journal Article	S&T	2	Ponds, P.D., and N. Burkardt. 2005. Cabeza Prieta National Wildlife Refuge visitors: behaviors and attitudes about recreation opportunities. Human Dimensions of Wildlife 10: 75-76.
Journal Article	S&T	2	Schroeder, R.L., J.I. Holler, and J.P. Taylor. 2004. Managing National Wildlife Refuges for historic or non-historic conditions: determining the role of the refuge in the ecosystem. Natural Resources Journal 44(4): 1185-1210.
Journal Article	S&T	2	Stanley, T.R. 2004. When should Mayfield model data be discarded?. Wilson Bulletin 116(3): 267-269.

Publication Type	Program	Goal	Citation
Abstract	S&T	2	Schroeder, R.L. 2004. Setting objectives for ecosystem restoration: an examination of National Wildlife Refuge Comprehensive Conservation Plans [abs.]. In: The first National Conference on Ecosystem Restoration (NCER): Sustainable ecosystem restoration through integration of science, planning and policy, December 6-10, 2004, Lake Buena Vista, FL. Lake Buena Vista, FL: Ecosystem Restoration Conference. p. 379.
Journal Article	S&T	2	Farmer, A., M. Abril, M. Fernandez, J. Torres, C. Kester, and C. Bern. 2004. Using stable isotopes to associate migratory shorebirds with their wintering locations in Argentina. <i>Ornitologia Neotropical</i> 15: 377-384.
Proceedings	S&T	2	Lamb, B.L., N. Burkardt, and D. Lybecker. 2004. Background and applications of the Legal-Institutional Analysis Model (LIAM) for management of infrastructures. In: Miyamoto, A., and H. Morata, (eds.). Proceedings of Infrastructure and Environmental Management symposium, Yamaguchi 2004. Ube, Yamaguchi, Japan: Infrastructures and Environmental Management Research Group, Y.U. p. 54-69.
USGS Series	S&T	2	Stanley, T.R., and S.K. Skagen. 2005. Interim progress report for project: Long-billed curlew ( <i>Numenius americanus</i> ) rangewide survey and monitoring guidelines. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. 19 p.
USGS Series	S&T	2	Taylor, J.G., S.C. Gillette, R.W. Hodgson, and J.L. Downing. 2005. Communicating with wildland interface communities during wildfire. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Open File Report 2005-1061. 26 p.
USGS Series	S&T	2	Taylor, J., and S. Gillette. 2005. Communicating with wildland interface communities during wildfire. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Fact Sheet 2005-3033. 2 p.
Journal Article	S&T	2	Lamb, B.L., C. Sabaton, and Y. Souchon. 2004. Use of Instream Flow Incremental Methodology: introduction to the special issue. <i>Hydroecologie Appliquee</i> 14(1): 1-7.
Journal Article	S&T	2	Lamb, B.L., C. Sabaton, and Y. Souchon, (eds.). 2004. Use of the Instream Flow Incremental Methodology: special issue. <i>Hydroecologie Appliquee</i> 14(1): 1-270.
USGS Series	S&T	2	Gillette, S., and B.L. Lamb. 2005. 2004 Reclamation Customer Satisfaction Survey. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. 92 + app p.
USGS Series	S&T	2	Neilsen, J.R., B.L. Lamb, E.M. Swann, J. Ratz, P.D. Ponds, and J. Liverca. 2005. Attitudinal survey component of the study "Quantity, Quality, and Support for Research in the U.S. Fish and Wildlife Service: An Organizational Assessment": Report of methods and frequencies. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. 11 p.

Publication Type	Program	Goal	Citation
Report	S&T	2	Caughlan, L. 2004. Regional economic effects of current and proposed management alternatives for Cabeza Prieta National Wildlife Refuge. In: . Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. p. 29.
Journal Article	S&T	2	Lamb, B.L., and N.P. Lovrich. 2005. Agency bargaining behavior in multi-party environmental negotiations: a symposium overview. <i>International Journal of Organization Theory and Behavior</i> 8(2): 175-180.
Journal Article	S&T	2	Lamb, B.L., and N.P. Lovrich, (eds.). 2005. Symposium on agency bargaining behavior in multi-party environmental negotiations: Part I. <i>International Journal of Organization Theory and Behavior</i> 8(2): 174-273.
USGS Series	S&T	2	Koontz, L., and D.L. Hoag. 2005. Analyzing stakeholder preferences for managing elk and bison at the National Elk Refuge and Grand Teton National Park: an example of the disparate stakeholder management approach. Fort Collins, Colorado: U.S. Geological Survey, Fort Collins Science Center. Open-File Report 2005-1224. 50 p.
Thesis & Dissert	S&T	2	Torres Dowdall, J.R. 2005. Uso de isotopos estables para relacionar los habitats estacionales de aves playeras nearticas [Using stable isotopes to link seasonal habitats of neartic shorebirds] [M.S. Thesis]. Cordoba, Argentina: Universidad Nacional de Cordoba. 58 p.

**Status and Trends of Biological Resources #3 - Collect, archive, and share selected, critical, high-quality monitoring data in cooperation with our partners to enable a determination of the status and trends of biological resources.**

Journal Article	S&T	3	Barclay, A.D., J.L. Betancourt, and C.D. Allen. 2004. Effects of seeding ryegrass ( <i>Lolium multiflorum</i> ) on vegetation recovery following fire in a ponderosa pine ( <i>Pinus ponderosa</i> ) forest. <i>International Journal of Wildland Fire</i> 13: 183-194.
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**Status and Trends of Biological Resources #4 - Produce and provide analyses and reports that synthesize information on the status and trends of our Nations flora, fauna, and ecosystems and are responsive to the needs of the scientific community, land and resource managers, policy makers, and the public.**

Journal Article	S&T	4	Jehle, G., A.A. Yackel Adams, J.A. Savidge, and S.K. Skagen. 2004. Nest survival estimation: a review of alternatives to the Mayfield estimator. <i>The Condor</i> 106: 472-484.
USGS Series	S&T	4	Gillette, S., J. Dein, M. Salman, B. Richards, and P. Duarte, (eds.). 2004. Chronic Wasting Disease Risk Analysis Workshop: an integrative approach. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Open-File Report 2004-1418. 53 p.



Publication Type	Program	Goal	Citation
USGS Series	S&T	4	Cryan, P.M. 2004. Synthesis of existing information on meadow jumping mice ( <i>Zapus hudsonius</i> ) in the northern Great Plains: an information review compiled for the U.S. Fish and Wildlife Service, Region 6, Denver, Colorado. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. 27 p.
USGS Series	S&T	4	Skagen, S.K., and C.P. Melcher. 2004. Final report: migration stopover ecology of western avian populations: patterns of geographic and habitat distribution (Quick Response Project Number QR-F3-03-07). Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. 17 p.
USGS Series	S&T	4	Skagen, S.K., C.P. Melcher, and R. Hazlewood. 2004. Migration stopover ecology of western avian populations: Southwestern migration workshop. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Open-File Report 2004-1452. 28 p.
Journal Article	S&T	4	Skagen, S.K., A.A. Yackel Adams, and R.D. Adams. 2005. Nest survival relative to patch size in a highly fragmented shortgrass prairie landscape. <i>Wilson Bulletin</i> 117(1): 23-34.
Journal Article	S&T	4	Skagen, S.K., J.F. Kelly, C. Van Riper, III, R.L. Hutto, D.M. Finch, D.J. Krueper, and C.P. Melcher. 2005. Geography of spring landbird migration through riparian habitats in southwestern North America. <i>Condor</i> 107(2): 212-227.
Journal Article	S&T	4	Heglund, P.J., and S.K. Skagen. 2005. Ecology and physiology of en route nearctic-neotropical migratory birds: a call for collaboration. <i>Condor</i> 107(2): 193-196.
USGS Series	S&T	4	Melcher, C.P., and S.K. Skagen. 2005. Grass buffers for playas in agricultural landscapes: a literature synthesis. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Open-File Report 2005-1220. 35 p.
Journal Article	S&T	4	Ellison, L.E., A.L. Everette, and M.A. Bogan. 2005. Examining patterns of bat activity in Bandelier National Monument, New Mexico, using walking point transects. <i>The Southwestern Naturalist</i> 50(2): 197-208.
USGS Series	S&T	4	Melcher, C.P., and S.K. Skagen. 2005. Grass buffers for playas in agricultural landscapes: an annotated bibliography. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Open-File Report 2005-1221. 46 p.

Publication Type	Program	Goal	Citation
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**Terrestrial, Freshwater and Marine Ecosystems #1 - Quantify and understand factors influencing patterns of temporal and spatial variability in key ecosystem components.**

Journal Article	ECO	I	Nydick, K.R., B.M. Lafrancois, and J.S. Baron. 2004. NO <sub>3</sub> uptake in shallow, oligotrophic, mountain lakes: the influence of elevated NO <sub>3</sub> concentrations. <i>Journal of the North American Benthological Society</i> 23(3): 397-415.
Book, Pages in	ECO	I	Baron, J.S., S. Del Grosso, D.S. Ojima, D.M. Theobald, and W.J. Parton. 2004. Nitrogen emissions along the Colorado Front Range: response to population growth, land and water use change, and agriculture. In: DeFries, R.S., G.P. Asner, and R.A. Houghton, (eds.). <i>Ecosystems and land use change</i> (Geophysical monograph series 153). Washington, DC: American Geophysical Union. p. 117-127.
Journal Article	ECO	I	Lafrancois, B.M., K.R. Nydick, B.M. Johnson, and J.S. Baron. 2004. Cumulative effects of nutrients and pH on the plankton of two mountain lakes. <i>Canadian Journal of Fisheries and Aquatic Sciences</i> 61: 1153-1165.
Journal Article	ECO	I	Peters, D.P.C., R.A. Peilke, Sr., B.T. Bestelmeyer, C.D. Allen, S. Munson-McGee, and K.M. Havstad. 2004. Cross scale interactions, nonlinearities, and forecasting catastrophic events. <i>Proceedings of the National Academy of Sciences</i> 101(42): 15130-15135.
Book, Pages in	ECO	I	Stromberg, J., M. Briggs, C. Gourley, M. Scott, P. Shafroth, and L. Stevens. 2004. Human alterations of riparian ecosystems. In: Baker, Jr., M.B., P.F. Ffolliott, L.F. DeBano, and D.G. Neary, (eds.). <i>Riparian areas of the southwestern United States: hydrology, ecology, and management</i> . Boca Raton, FL: CRC Press/Lewis Publishers. p. 99-126.
Book, Pages in	ECO	I	Stromberg, J., M. Briggs, M. Scott, and P. Shafroth. 2004. Riparian ecosystem assessments. In: Baker, Jr., M.B., P.F. Ffolliott, L.F. DeBano, and D.G. Neary, (eds.). <i>Riparian areas of the southwestern United States: hydrology, ecology, and management</i> . Boca Raton, FL: CRC Press/Lewis Publishers. p. 315-331.
USGS Series	ECO	I	U.S. Geological Survey. 2004. Fort Collins Science Center: Ecosystem Dynamics. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Fact Sheet 2004-3147. 2 p.
Book, Pages in	ECO	I	Allen, C.D. 2005. A thousand years of ecological continuity and change on the Pajarito Plateau. In: Powers, R.P. (ed.). <i>The peopling of Bandelier: new approaches to the archeology of the Pajarito Plateau</i> . Santa Fe, NM: School of American Research Press. p. 11-18.
USGS Series	ECO	I	Kotliar, N. 2005. Integrated fire science in the Rocky Mountains. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Fact Sheet 2005-3032. 2 p.

Publication Type	Program	Goal	Citation
Journal Article	ECO	I	Auble, G.T. 2005. Book review -- Great Basin Riparian Ecosystems: Ecology, Management, and Restoration. <i>Restoration Ecology</i> 13(1): 237-238.
Journal Article	ECO	I	Auble, G.T., M.L. Scott, and J.M. Friedman. 2005. Use of individualistic streamflow-vegetation relations along the Fremont River, Utah, USA to assess impacts of flow alteration on wetland and riparian area. <i>Wetlands</i> 25(1): 143-154.
Book, Pages in	ECO	I	Allen, C.D. 2005. A thousand years of ecological continuity and change on the Pajarito Plateau. In: Powers, R.P. (ed.). <i>The peopling of Bandelier: new approaches to the archeology of the Pajarito Plateau</i> . Santa Fe, NM: School of American Research Press. p. 11-18.
USGS Series	ECO	I	Kotliar, N. 2005. Integrated fire science in the Rocky Mountains. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Fact Sheet 2005-3032. 2 p.
Journal Article	ECO	I	Auble, G.T. 2005. Book review -- Great Basin Riparian Ecosystems: Ecology, Management, and Restoration. <i>Restoration Ecology</i> 13(1): 237-238.
Journal Article	ECO	I	Auble, G.T., M.L. Scott, and J.M. Friedman. 2005. Use of individualistic streamflow-vegetation relations along the Fremont River, Utah, USA to assess impacts of flow alteration on wetland and riparian area. <i>Wetlands</i> 25(1): 143-154.
Journal Article	ECO	I	Katz, G.L., J.M. Friedman, and S.W. Beatty. 2005. Delayed effects of flood control on a flood-dependent riparian forest. <i>Ecological Applications</i> 15(3): 1019-1035.

**Terrestrial, Freshwater and Marine Ecosystems #3 - Develop indexes of ecosystem sensitivity to change and vulnerability to potential stressors, and tools to predict ecosystem responses to environmental change.**

Journal Article	ECO	3	Nydick, K.R., B.M. Lafrancois, J.S. Baron, and B.M. Johnson. 2004. Nitrogen regulation of algal biomass, productivity, and composition in shallow mountain lakes, Snowy Range, Wyoming, USA. <i>Canadian Journal of Fisheries and Aquatic Sciences</i> 61: 1256-1268.
Journal Article	ECO	3	Meyerson, L.A., J. Baron, J.M. Melillo, R.J. Naiman, R.I. O'Malley, G. Oriens, M.A. Palmer, A.S.P. Pfaff, S.W. Running, and O.E. Sala. 2005. Aggregate measures of ecosystem services: can we take the pulse of nature?. <i>Frontiers in Ecology and Environment</i> 3(1): 56-59.

Publication Type	Program	Goal	Citation
USGS Series	ECO	3	Baron, J. 2005. Taking the pulse of Colorado's Front Range: developing regional indicators of environmental and quality of life condition. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Fact Sheet 2005-3021. 2 p.

**Terrestrial, Freshwater and Marine Ecosystems #4 - Devise a restoration and adaptive management framework for impaired ecosystems.**

Journal Article	ECO	4	Douglas, A.J., and R.L. Johnson. 2004. The travel cost method and the economic value of leisure time. <i>International Journal of Tourism Research</i> 6: 365-374.
USGS Series	ECO	4	Ransom, J., F.J. Singer, and L. Zeigenfuss. 2005. Annual report for 2004 wild horse research and field activities. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Open-File Report 2005-1316. 19 p.

**Wildlife and Terrestrial Resources #1 - Provide the Scientific Foundation for the Conservation of Terrestrial Plants, Wildlife, and Habitats by developing the basic biological information that partners need to formulate adaptive management strategies.**

Journal Article	WTR	I	Albert, S., C.A. Ramotnik, and C.G. Schmitt. 2004. Collard peccary range expansion in northwestern New Mexico. <i>The Southwestern Naturalist</i> 49(4): 524-528.
Journal Article	WTR	I	Sedgwick, J.A., and J. Bartholow. 2004. Foxes on a hot tin roof. <i>Western North American Naturalist</i> 64(3): 406-408.
Journal Article	WTR	I	Iko, W.M., S.J. Dinsmore, and F.L. Knopf. 2004. Estimating the use of morphometric measurements from museum specimens for sex determination in Mountain Plovers ( <i>Charadrius montanus</i> ). <i>Western North American Naturalist</i> 64(4): 492-496.
Journal Article	WTR	I	Lukacs, P.M., V.J. Dreitz, F.L. Knopf, and K.P. Burnham. 2004. Estimating survival probabilities of unmarked dependent young when detection is imperfect. <i>The Condor</i> 106: 926-931.
Report	WTR	I	Knopf, F.L. 2004. American White Pelican ( <i>Pelecanus erythrorhynchos</i> ). In: <i>The Birds of North America Online</i> . Ithaca, NY: Cornell Laboratory of Ornithology. p. online only.
Thesis & Dissert	WTR	I	Mohan, H.M. 2004. Foraging ecology in White-tailed Kites ( <i>Elanus leucurus</i> ) [M.S. Thesis]. Macomb, ILL: Western Illinois University. 36 p.
Journal Article	WTR	I	Campbell, D.H., E. Muths, J.T. Turk, and P.S. Corn. 2004. Sensitivity to acidification of subalpine ponds and lakes in north-western Colorado. <i>Hydrological Processes</i> 18: 2817-2834.

Publication Type	Program	Goal	Citation
USGS Series	WTR	I	U.S. Geological Survey. 2004. Fort Collins Science Center: Species and Habitats of Federal Interest. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Fact Sheet 2004-3148. 2 p.
Proceedings	WTR	I	O'Shea, T.J. 2005. Marine mammals and environmental contaminants in the Pacific ocean: current knowledge and frontiers for research. In: Miyazaki, N., Z. Adeel, and K. Ohwada, (eds.). Mankind and the oceans: proceedings of the Joint International Conference 'Man and the Ocean'. Tokyo, Japan: United Nations University Press. p. 111-136.
Journal Article	WTR	I	Lehmer, E.M., and D.E. Biggins. 2005. Variation if torpor patterns of free-ranging black-tailed and Utah prairie dogs across gradients of elevation. <i>Journal of Mammalogy</i> 86(1): 15-21.
Journal Article	WTR	I	Plumb, R.E., F.L. Knopf, and S.H. Anderson. 2005. Minimum population size of Mountain Plovers breeding in Wyoming. <i>Wilson Bulletin</i> 117(1): 15-22.
Journal Article	WTR	I	Oyler-McCance, S.J., J. St. John, F.L. Knopf, and T.W. Quinn. 2005. Population genetic analysis of Mountain Plover using mitochondrial DNA sequence data. <i>Condor</i> 107: 353-362.
Journal Article	WTR	I	Oyler-McCance, S.J., S.E. Taylor, and T.W. Quinn. 2005. A multilocus population genetic survey of greater sage-grouse across their range. <i>Molecular Ecology</i> 14: 1293-1310.
Journal Article	WTR	I	Oyler-McCance, S.J., J. St. John, J.M. Parker, and S.H. Anderson. 2005. Characterization of microsatellite loci isolated in midget-faded rattlesnakes ( <i>Crotalus viridis concolor</i> ). <i>Molecular Ecology Notes</i> 5: 452-453.
Journal Article	WTR	I	Plumb, R.E., S.H. Anderson, and F.L. Knopf. 2005. Habitat and nesting biology of Mountain Plovers in Wyoming. <i>Western North American Naturalist</i> 65(2): 223-228.
USGS Series	WTR	I	Iko, W.M., R.J. Dusek, and E.K. Hofmeister. 2005. Measuring the effects of West Nile Virus on wild American Kestrel ( <i>Falco sparverius</i> ) populations in Colorado-2004 Year-End Report. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. 10 p.
USGS Series	WTR	I	Ramotnik, C.A., D. Alba, and D. Dominguez. 2005. Impact of the Scott Able fire on salamander abundance and arthropod prey base: year four. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. p.
USGS Series	WTR	I	Ruth, J.M. 2005. Distribution and abundance of breeding Arizona Grasshopper Sparrow ( <i>Ammodramus savannarum ammodramus</i> ), and associated priority grassland species, in the Southwestern U.S. - 2004. Fort Collins, Colorado: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. 29 + tables & apps p.



Publication Type	Program	Goal	Citation
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**Wildlife and Terrestrial Resources #2 - Provide tools and techniques, such as predictive models, decision support, and expert systems, for science-based management of wildlife and plant populations and their habitats.**

Journal Article	WTR	2	Cryan, P.M., M.A. Bogan, R.O. Rye, G.P. Landis, and C.L. Kester. 2004. Stable hydrogen isotope analysis of bat hair as evidence for seasonal molt and long-distance migration. <i>Journal of Mammalogy</i> 85(5): 995-1001.
Journal Article	WTR	2	Cade, B.S., B.R. Noon, and C.H. Flather. 2005. Quantile regression reveals hidden bias and uncertainty in habitat models. <i>Ecology</i> 86(3): 786-800.
Journal Article	WTR	2	Zoellick, B.W., H.M. Ulmschneider, B.S. Cade, and A.W. Stanley. 2004. Isolation of Snake River islands and mammalian predation of waterfowl nests. <i>Journal of Wildlife Management</i> 68(3): 650-662.
Journal Article	WTR	2	Baker, B.W., H.C. Ducharme, D.C.S. Mitchell, T.R. Stanley, and H.R. Peinetti. 2005. Interaction of beaver and elk herbivory reduces standing crop of willow. <i>Ecological Applications</i> 15(1): 110-118.
Journal Article	WTR	2	Williams, C.L., S.W. Breck, and B.W. Baker. 2004. Genetic methods improve accuracy of gender determination in beaver. <i>Journal of Mammalogy</i> 85(6): 1145-1148.
Journal Article	WTR	2	Boyle, T.P., S.M. Caziani, and R.G. Waltermire. 2004. Landsat TM inventory and assessment of waterbird habitat in the southern altiplano of South America. <i>Wetlands Ecology and Management</i> 12: 563-573.
Book, Pages in	WTR	2	O'Shea, T.J., L.E. Ellison, and T.R. Stanley. 2004. Survival estimation in bats: historical overview, critical appraisal, and suggestions for new approaches. In: Thompson, W.L., (ed.). <i>Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters</i> . Washington, D.C.: Island Press. p. 297-336.
Popular Article	WTR	2	Cryan, P. 2004. Chemistry & migration mysteries: fur holds clues to previous journeys. <i>Bats</i> 22(3): 12-13.
Proceedings	WTR	2	Baker, B.W., D.C.S. Mitchell, H.C. Ducharme, T.R. Stanley, and H.R. Peinetti. 2004. Why aren't there more beaver in Rocky Mountain National Park. In: <i>Wildlife &amp; riparian areas: Colorado Riparian Association seventeenth annual conference, October 13-15, 2004, Estes Park, Colorado</i> . Estes Park, CO: Colorado Riparian Association. p. 85-90.
Proceedings	WTR	2	Westbrook, C.J., D.J. Cooper, and B.W. Baker. 2004. Beaver vs. floods in controlling hydrological processes on floodplains. In: <i>Wildlife &amp; riparian areas: Colorado Riparian Association seventeenth annual conference, October 13-15, 2004, Estes Park, Colorado</i> . Estes Park, CO: Colorado Riparian Association. p. 91-93.

Publication Type	Program	Goal	Citation
Proceedings	WTR	2	Westbrook, C.J., D.J. Cooper, B.W. Baker, and L.H. MacDonald. 2004. Relative importance of beaver and low recurrence-interval floods in controlling water table position of mountain riparian wetlands. In: Herrmann, A., (ed.). International Conference on Hydrology of Mountain Environments, Berchtesgaden, Federal Republic of Germany, 27 September - 1 October 2004; Landschaftsökologie und Umweltforschung Vol. 47. Braunschweig, Germany: Inst. für Geographie und Geoökologie. p. 423-427.
USGS Series	WTR	2	Baker, B.W., D. Cooper, C. Westbrook, K. Czarnowski, T. Johnson, R. Monello, H.R. Peinetti, T. Stanley, and D. Mitchell. 2005. Declining beaver populations in Rocky Mountain National Park: Final report; NRPP 99-04 (ROMO); 10 January 2005. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. 83 p.
USGS Series	WTR	2	O'Shea, T.J., P.M. Cryan, D.J. Neubaum, and M.A. Hayes. 2005. Bats in Fort Collins natural areas and parks: results of studies during 2004. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. USGS Administrative Report. 24 p.
Journal Article	WTR	2	Wimsatt, J., T.J. O'Shea, L.E. Ellison, R.D. Pearce, and V.R. Price. 2005. Anesthesia and blood sampling of wild big brown bats ( <i>Eptesicus fuscus</i> ) with an assessment of impacts on survival. <i>Journal of Wildlife Diseases</i> 41(1): 87-95.
Book, Pages in	WTR	2	Cade, B.S. 2005. Linear models: permutation methods. In: Everitt, B.S., and D.C. Howell, (eds.). <i>Encyclopedia of statistics in behavioral science</i> , volume 2. Chichester, West Sussex: John Wiley & Sons, Ltd. p. 1049-1054.
USGS Series	WTR	2	Sojda, R., J.M. Ruth, W.C. Barrow, D.K. Dawson, R.H. Diehl, A. Manville, M.T. Green, D.J. Krueper, and S. Johnston. 2005. Using radar to advance migratory bird management: an interagency collaboration. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Fact Sheet 2005-3048. 2 p.
USGS Series	WTR	2	Ruth, J.M., W.C. Barrow, R.S. Sojda, D.K. Dawson, R.H. Diehl, A. Manville, M.T. Green, D.J. Kreuper, and S. Johnston. 2005. Advancing migratory bird conservation and management by using radar: an interagency collaboration. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Open-File Report 2005-1173. 12 p.
USGS Series	WTR	2	Knopf, F.L. and M.B. Wunder. 2005. Toward a survey design to monitor wintering mountain plovers: final report to U.S. Fish and Wildlife Service [Region 6]. Fort Collins, CO: U.S. Geological Survey, Fort Collins Science Center. Administrative Report. 20 p.

Publication Type	Program	Goal	Citation
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**Wildlife and Terrestrial Resources #3 - Identify the factors that contribute to and/or limit the conservation and recovery efforts for terrestrial plant and wildlife species-at-risk.**

Journal Article	WTR	3	Schoenecker, K.A., F.J. Singer, L.C. Zeigenfuss, D. Binkley, and R.S.C. Menezes. 2004. Effects of elk herbivory on vegetation and nitrogen processes. <i>Journal of Wildlife Management</i> 64(4): 837-849.
Journal Article	WTR	3	Schoenecker, K.A., R.O. Lyda, and J. Kirkpatrick. 2004. A comparison of three fecal steroid metabolites for pregnancy detection used with single sampling in bighorn sheep ( <i>Ovis canadensis</i> ). <i>Journal of Wildlife Diseases</i> 40(2): 273-281.
Proceedings	WTR	3	Singer, F.J., L.C. Zeigenfuss, and R. Stottlemeyer. 2004. Ungulate grazing systems compared between the greater Yellowstone Area and East Africa. In: Biel, A.W. (ed.). <i>Beyond the arch: community and conservation in Greater Yellowstone and East Africa</i> . Proceedings of the 7th biennial scientific conference on the Greater Yellowstone Ecosystem, October 6-8, 2003, Mammoth Hot Springs Hotel, Yellowstone Nat. Yellowstone National Park, WY: Yellowstone Center for Resources. p. 304-318.

## Other FORT Products Delivered in FY2005

### Product Type    Program    Goal    Citation

#### **Biological Informatics #2 – Develop, integrate, and apply tools that maximize the efficiency and effectiveness of user interactions with biological data and information.**

Web application	BIO	2	WAFER - Water and Fire Environmental Resources (available on NBII SWIN)
Web application	BIO	2	Southwest Threatened and Endangered Species (available on NBII SWIN)

#### **Fisheries: Aquatic and Endangered Resources #2 - Provide scientific information about factors and processes that affect aquatic organism health in support of survival, protection, conservation and recovery.**

Software	FAER	2	Henriksen, J. Hydroecological Integrity Assessment Process (HIP) – Four Windows-based programs to (1) classify streams using 171 indices, (2) establish a hydrologic baseline, (3) establish environmental flow standards, and (4) evaluate past and proposed hydrologic modifications.
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#### **Invasive Species #1 - Provide and coordinate the collection, synthesis, and accessibility of invasive species information (Information Management Goal)**

Software	INV	1	National Institute of Invasive Species Science website integration with NASA modeling tools - version 1.0.
Software	INV	1	Shory, R. 2005. EcoNab - version 1.1.0. Palm software program to collect any type of field vegetation survey data.
Software	INV	1	Shory, R. 2005. VegSurvey - version 1.1.0. Access database with built in queries to analyze data.
Software	INV	1	Graham, J.J., C.S. Jarnevich, G.J. Newman, T.J. Stohlgren, and R. Shory. 2005. Global Organism Detection and Monitoring System SQL-Server Database version 1. Stores integrated data on species locations, their attributes, and control efforts.
Database	INV	1	Stohlgren, T.J. GIS database of expert opinions on tamarisk invasions in the West.

#### **Status and Trends of Biological Resources #2 - Develop and evaluate inventory and monitoring methods, protocols, experimental designs, analytic tools, models, and technologies to measure biological status and trends.**

Workshop module	S&T	2	Schroeder, R. FWS Habitat Management Planning Training Modules - Lesson 3: Developing Habitat-Based Goals and Objectives; Lesson 4: Selecting Habitat Management Strategies.
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Product Type	Program	Goal	Citation
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Software	S&T	2	Stanley, T. CloseTest. A Windows-based program for testing capture-recapture data for closure, where closure means no individuals were added to or lost for the population of interest over the sampling period.
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**Wildlife and Terrestrial Resources #2 - Provide tools and techniques, such as predictive models, decision support, and expert systems, for science-based management of wildlife and plant populations and their habitats.**

Software	WTR	2	Cade, B. Updates to Blossom Statistical Software. An interactive program for making statistical comparisons with distance-function permutation tests and for testing parameters estimated in linear models with permutation procedures.
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## **APPENDIX 2. FORT FY2005 APPOINTMENTS AND PRESENTATIONS**

### **Association and Committee Appointments and Editorships**

- A. Science Impact Program** (90-day Detail to staff at USGS Headquarters)  
*Lynne Koontz, Detailee*
- B. Fire Social Science Committee** (Interagency committee with USGS, Forest Service, and Bureau of Land Management)  
*Jonathan Taylor and Shana Gillette, Members*
- C. Rocky Mountain Chapter of the Ecological Society of America**  
*Thomas J. Stohlgren, Vice-Chair (2003-2005). He is also on the Editorial Board (Ecology and Ecological Monographs) and assists in Public Affairs (Immediate Response).*
- D. Western Social Science Association**  
*Phadrea Ponds, Vice-President*
- E. USGS, Partners in Flight**  
*Janet Ruth, Co-Coordinator: Received letter of recognition in October 2004 from Partners in Flight (PIF) National Coordinator for Janet's long-standing involvement and contributions to PIF, including her work and leadership of the Research Working Group of PIF, developing the PIF Web page, and dialogues on the scientific aspects of landbird conservation.*
- F. Wilson Bulletin**  
*Jim Sedgwick, Editor*
- G. Executive Board of the U.S. Shorebird Planning Council**  
*Susan Skagen, Board Member*
- H. Research and Monitoring Working Group of the U.S. Shorebird Conservation Plan**  
*Susan Skagen, Member*
- I. Western Hemisphere Shorebird Reserve Network Advisory Group**  
*Susan Skagen, Member of and chair of task force for the Advisory Group*
- J. Advisory Group to the National Park Service's Inventory and Monitoring Council**  
*Brian Cade, USGS representative*
- K. Marine Mammal Committee of the American Society of Mammalogists**  
*Thomas O'Shea, Chair*
- L. Scientific Advisory Committee of Bats and Wind Energy Cooperative**  
*Paul Cryan, Member*

**M. Cooper Ornithological Society***Fritz Knopf, Director; three-year term 2005-2007***N. National Center for Ecological Analysis and Synthesis, Science Advisory Board***Jill Baron, Member***O. Rocky Mountain Ecological Observatory Network (ROMEO)***Jill Baron, Co-chair***P. National Ecological Observatory Network (NEON) Design Committee***Jill Baron, Member***Q. Board of Directors of the Mountain Studies Institute***Jill Baron, Member***R. American Society for Limnology and Oceanography Hutchinson Award Committee***Jill Baron, Member***S. Science Advisory Board, Grand Canyon Monitoring and Research Center/Glen Canyon Dam Adaptive Management Program***Jill Baron, Member***T. Science Advisory Board of the Northern Colorado Plateau Inventory and Monitoring Program***Jill Baron, Member***U. Interagency saltcedar team** (devoted to planning and evaluating research, monitoring, and management activities)*Pat Shafroth, USGS Representative (selected by the USGS Invasive Species Program Coordinator)***V. Elwha Research Planning Workshop***Pat Shafroth, Session Chair***W. Coastal Rivers Research Consortium***Pat Shafroth, USGS Representative***X. Bill Williams River Corridor Steering Committee and The Nature Conservancy's Sustainable Waters Program***Pat Shafroth, invited to be the Lead Scientist in an adaptive management project on the Bill Williams River***Y. National Research Council River Science Committee***Zack Bowen, USGS-BRD representative*

- Z. Science Committee of the National Fish Habitat Initiative** sponsored by the International Association of Fish and Wildlife Agencies  
*Zach Bowen, Member*

### Invited Presentations

- A.** Allen, C.D. and J. L. Betancourt. 2005. **Ecosystems in transition: Climate change research in southwestern national parks.** George Wright Society Biennial Conference on Parks, Protected Areas and Cultural Sites. Philadelphia, PA.
- B.** Auble, G.T. 2005. Riparian willow restoration at Arapaho NWR and effects of ungulate browsing on post-fire recovery of cottonwoods and willow at Seedskaadee NWR. **U.S. Fish and Wildlife Service, Region 6 Research Colloquium**, Denver, CO.
- C.** Auble, G.T. and M.L. Scott. 2005. Cottonwood along the Wild and Scenic reach of the upper Missouri River in the Missouri Breaks National Monument. **Wildlife Technical Advisory Committee, PPL-MT Mitigation and Enhancement Program**, Bozeman, MT.
- D.** Auble, G.T. 2005. Vegetation models to inform streamflow alteration decisions. **USGS Workshop: Linking hydrologic change and ecological response in streams and rivers of the eastern United States.** Herndon, VA, February 8-10, 2005.
- E.** Auble, G. T. and Z. H. Bowen. 2005. Analysis alternatives for cumulative impact assessment along the Upper Yellowstone River, Montana. **Upper Yellowstone Cumulative Impacts Interagency Working Group**, Helena, MT.
- F.** Baron, J. 2005. Nitrogen deposition in the Rocky Mountains: Causes and consequences. U. C. Riverside, **Symposium on Western Atmospheric Deposition to Mountains, Aglands, and Deserts.** Riverside, CA.
- G.** Baron, J. 2005. Consequences of nitrogen deposition in Rocky Mountain National Park. **Colorado Departments of Environmental Health Annual Meeting**, Aspen, CO.
- H.** Baron, J. 2005. The Value of Long-Term Monitoring Data in Alpine Catchments for Indicating Climatic and Environmental Change. **Gordon Research Conference**, Maine.
- I.** Baron, J. 2005. Appropriation of Mountain Resources across Altitudinal Gradients in the Rocky Mountains, and possible remedies. **GLOCHAMORE Workshop**, Switzerland.
- J.** Bowen, Z. H., K. D. Bovee, and T. J. Waddle. 2005. Modeling effects of flow and channel modifications on river habitats. **River Management Society Interagency Workshop.** Salt Lake City, UT.
- K.** Friedman, J.M., G.T. Auble, M.L. Scott, P.B. Shafroth, M.F. Merigliano, M.D. Freehling, R.E. Evans, and E.R. Griffin. 2005. Influence of phenology, climate, and flow regime on abundance of woody riparian plants in the western USA. **Annual Meeting of the Association of American Geographers**, Denver CO.

- L. Ransom, J., B. Lubow, F.J. Singer. 2005. Aerial population estimation research for wild horses. Presentation for **Bureau of Land Management State Meeting, Nevada State Office of the BLM**, Reno, NV.
- M. Shafroth, P.B. and V. Beauchamp. 2005. Streamflow – riparian vegetation relations along the Bill Williams R. Presented at the **Bill Williams River Corridor Ecosystem Flow Workshop**, Tempe, AZ.
- N. Berton Lee Lamb, Policy Analysis and Science Assistance Branch Chief, invited to lecture at **Infrastructure and Environmental Management Symposium, Faculty of Engineering**, Yamaguchi University, Ube City, Japan; December 2004.
- O. **Advanced and Basic Negotiation Courses at FORT.** Nina Burkardt, Lee Lamb, Natalie Sexton, Phadrea Ponds, and Shana Gillette, course instructors; 4 courses held during FY05.
- P. Sandra L. Haire, invited speaker at **The Nature Conservancy's Southwest Fire Learning Network** meeting in Silver City, NM, presented "Crown Fire in Ponderosa Pine Forests: A Landscape Ecological Perspective"; February 2005.
- Q. James Stanford, coordinator for the Brown Treesnake (BTS) Rapid Response Team (RRT), continues to conduct outreach campaigns throughout the Pacific. His goal is to educate people who deal with incoming cargo and air flights to be aware of the threat of the snake and how to respond if a BTS is encountered. **This past year, James gave presentations to airport quarantine, Mobil Oil, Shell Oil, CBI (federal express shipping), and the longshoremen (ship cargo handlers) on Palau.** James also continues to conduct BTS RRT training. Participants are welcome from anywhere, but generally hail from Micronesia and Hawaii. Visual night snake searching and other techniques used in RR are taught. This year, James has conducted 4 courses, which have included trainees from **Hawaii and the Commonwealth of the Northern Mariana Islands.**
- R. John Bartholow made a presentation to the **Climate Impacts Group, University of Washington**, Seattle titled "Are fish in hot water?"; November 2004.